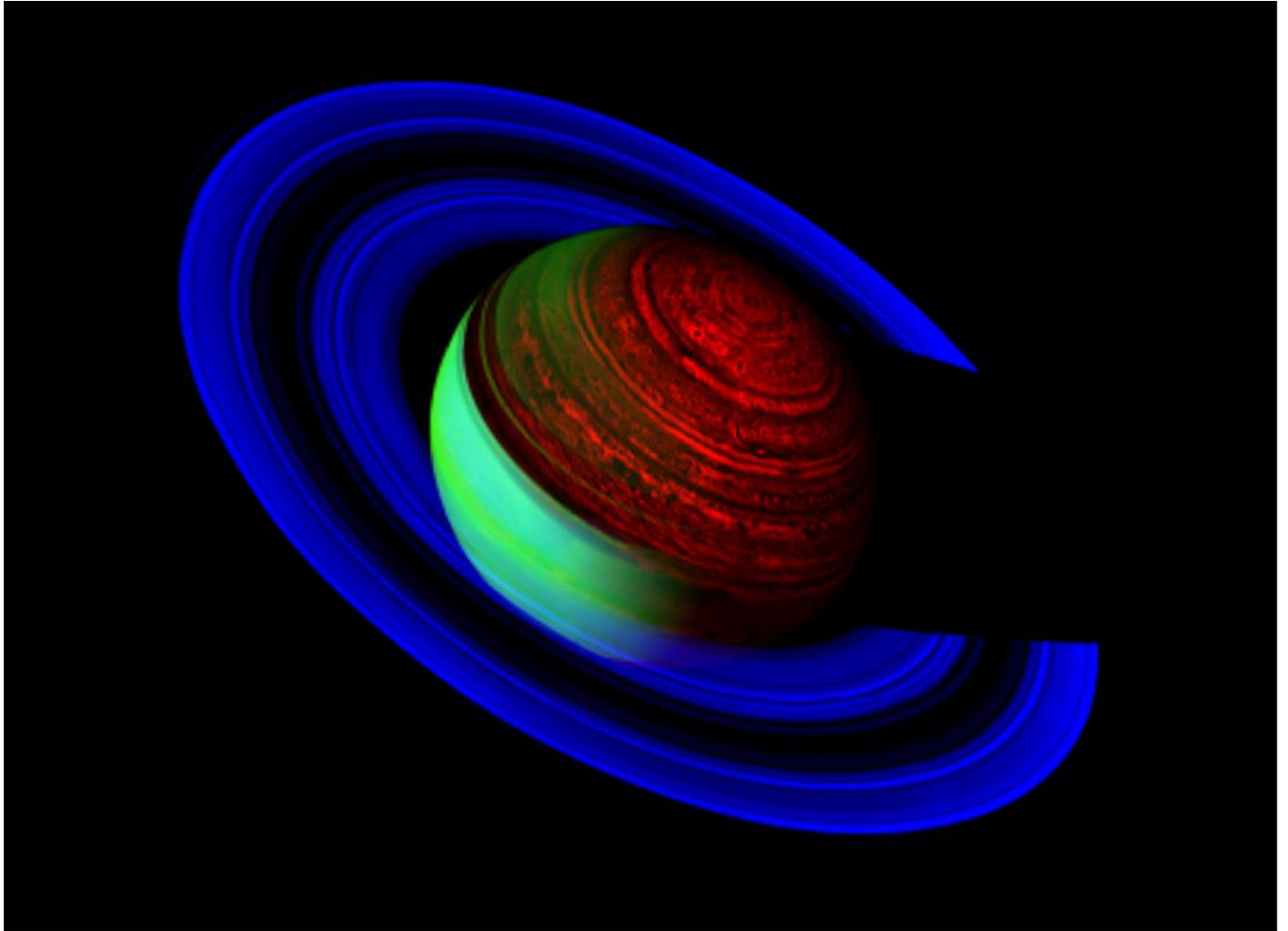


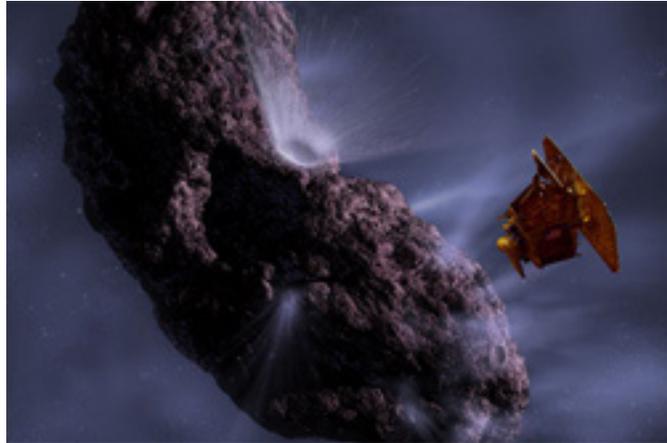
*Planetarium Activities for Student Success*

# *Using a Portable Planetarium*



*by Gerald Mallon*  
*revised by Alan Gould and JohnMichael Seltzer*

*False color image of Saturn  
courtesy NASA/JPL-Caltech/  
Cassini mission.*



Deep Impact was a mission to rendezvous with and crash into a comet. Illustration courtesy NASA.

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## ***Introduction***

A portable planetarium is truly a unique piece of equipment. More than just a place to look at stars, it is an environment in which you, the presenter can introduce participants to a wide range of topics including mathematics, social studies, language arts and of course, science. Unlike large, fixed-domed structures that commonly seat hundreds of people, portable planetariums are relatively small, usually designed to accommodate between 30 and 60 individuals. Because of this intimate setting, a portable planetarium is ideally suited for highly interactive workshops where audience members actually participate in the program rather than act as spectators. Often, it's this extra level of involvement that really makes the difference in getting an individual to truly understand what is happening in the world around them.

As with any piece of educational equipment, in order for a planetarium to be an effective teaching tool, it's critical that you, the instructor be completely familiar with its operation. Once you have a good grasp of the "physical plant" then you can use your creativity and teaching skills to their maximum potential.

Obviously, the details of operation will vary from one planetarium to another. The positions of switches and the projection capabilities will differ, as will the specific set-up and break down procedures. Even with these differences, the general function of most systems will be the same because ultimately, they are all designed to do the same basic task, re-create the night sky.

The primary purpose of this manual is to provide you with a resource for portable and small planetarium usage, and give step-by-step directions for operating the Portable Planetarium System, the most commonly used portable planetarium system in the world today. Since 1977 educators have been using Portable planetariums and while these systems have undergone some minor modifications over the years, their basic operation has not really changed. All Portable planetariums feature an inflatable dome, a high volume fan and a projector that uses interchangeable projection cylinders. Currently, there are two different types of Portable planetarium projectors. The Standard Projector, which has been in use for over 25 years, features a halogen cycle incandescent bulb with a small filament that lights the projection cylinders directly. The FiberArc Projector, introduced in the fall of 2002, uses a brighter arc-light lamp and fiber optics to bring the light to the cylinder. Both projectors can accommodate standard projection cylinders.

Even if you do not use a Portable planetarium planetarium, you'll find that this manual contains many valuable tips and suggestions that work well with other portable (as well as small permanent) planetariums. Many of the interactive teaching strategies presented here have been used over the years in countless planetariums around the world with a high degree of success. By following this guide and using these instructional techniques in your planetarium, not only will you inspire your students to learn more about the world around them but also perhaps you might even instill in them a love for astronomy that will stick with them for the rest of their lives.

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## ***A Short History of Portable Planetariums***

“Let there be light!” In 1923, the heavens were recreated for the first time through a projection device known as a **planetarium**. Invented by a talented craftsman named Dr. Walter Bauersfeld working at the Carl Zeiss Company in Germany, this device could realistically represent the sky from any place on Earth and from almost any point in time. It was a marvel of its day.

Planetariums soon started appearing in the larger cities of the world. The first planetarium in North America was the Adler Planetarium in Chicago, opening in 1930. As time went by, more cities added planetariums to various cultural and educational institutions. In 1933 the Fels Planetarium of the Franklin Institute and Science Museum in Philadelphia became the second planetarium in the United States. The Fels was the first planetarium to present programs to both the general public and school groups.

One of the people involved in presenting planetarium programs at the Fels was the planetarium’s Director of Education, Armand Spitz. Spitz was intrigued with the power that the planetarium could bring to teaching. He described the planetarium as “the greatest single teaching instrument ever invented.” Spitz was captivated with the idea of making the planetarium available to schools, and succeeded in creating a smaller, less expensive projector. He founded a company to produce these planetariums. Other planetarium manufacturers also started producing smaller planetariums and as a result, hundreds of smaller facilities now exist around the world, many of them in schools.

The smaller planetariums have much in common with their larger counterparts. They consist of a domed room and a planetarium projector. The main projector uses a system of lenses and lights to show a representation of the night sky for different latitudes on the Earth and for different days of the year. In addition to the stars, most can also project the Sun, moon and five visible planets. Some planetarium projectors can also demonstrate the motion called precession, and thus can demonstrate what the sky looked like thousands of years ago as well as how it will be seen in the future.

At first, the majority of these smaller planetariums only presented programs that were similar, if not identical, to the ones presented in the larger facilities. As time passed however, some educators began investigating the unique nature of smaller planetariums. These facilities permitted an intimacy that was not possible in the larger planetariums. Large planetariums typically seat two to three hundred people and while their shows are engaging, the audience members are simply passive recipients of information. Most small planetariums accommodate fewer than one hundred people and in this setting, the visitor has the opportunity to ask questions and to participate in activities. In this case, a visit to a planetarium is truly an interactive experience and the visitor has a real opportunity to discover the wonders of the night sky.

Small planetariums have a powerful role to play in education. Research has shown that they are quite effective in increasing knowledge and improving attitudes of the students who experience them. They have helped students comprehend the complexities of the universe and increase their reasoning skills.

Planetariums have given students new insight into the scientific method and clearly demonstrate the interdisciplinary nature of life. Given the capabilities and potential of smaller planetariums, their future in schools would seem to be extremely bright. Unfortunately, even small-scale permanent planetariums are very expensive propositions. As a result, after an initial construction boom that coincided with the “space race” of the 1960s, there was a sharp drop in the number of planetariums that were built. Over the next 30 years, many of these small planetariums fell into disrepair and because of budget cuts, a large number were forced to shut down. While student numbers increased, the availability of planetariums steadily declined.

One answer to this problem came in the late 1970s with the invention of the portable planetarium. These are facilities that can be erected and dismantled inside a building in a matter of minutes. When they are not in use, they can be placed in storage allowing the same space to be used for other activities. Because they don't require a dedicated structure like a permanent planetarium would, they are ideal for institutions that are faced with space issues due to overcrowding. Costing a fraction of the price of a permanent planetarium, most portables do an adequate job of recreating the night sky. Some systems can also be used to project images as varied as weather patterns, tectonic plate motions, the inner workings of a cell, and ocean currents making them a truly interdisciplinary device. As the use of portable planetariums continues to grow, more and more educators are finding that these clever devices are perfect for empowering their students, allowing them to discover the wonders of the universe for themselves.

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## ***Portable Planetarium Systems***

Invented in 1977 by Dr. Philip M. Sadler, the Portable planetarium Planetarium System became one of the most successful and widely used portable planetariums in the world. It consists of an inflatable dome in one of two sizes—16 feet (4.8m) or 22 feet (6.7m) in diameter, a projector and a high volume fan which is used to inflate the dome. The projection system is simply a light source that accommodates a variety of interchangeable projection cylinders that change the images projected on the dome.

Since that time a number of other portable planetarium systems have been introduced by a variety of planetarium companies, including Sky-Skan, Goto, Minolta, and Zeiss.

Planetariums reach their full potential as teaching tools when visitors become active participants rather than simply being spectators inside the dome. Because a portable is a small intimate planetarium, it is ideally suited for these participatory style programs. As a result, visitors can actively explore a problem, perform activities, and perhaps most importantly, ask questions of the instructor. In this way, the instructor becomes less of a “sage on the stage” and assumes the role of “guide on the side.”

Because portables are so versatile, they can be used for a variety of applications. The majority of systems that are sold are used by teachers in schools to present lessons to students who range in age from pre-schoolers to seniors in high school. In addition, many systems have been purchased by museums and large permanent planetariums and are used for outreach programs or “in school field trips.” Finally, a growing number of individuals and organizations have also purchased portable systems and use them in a business presenting astronomy programs for schools, scouting groups, star parties and even birthdays.

### ***Room Requirements for Using a Portable Planetarium***

The type of room that you select to set up a portable planetarium will depend on size of dome is being used. For a 16-foot dome, a minimum ceiling height of 10.5 feet is needed with a cleared square floor space 21 feet on a side. This can fit into most classrooms that have had the desks and chairs removed. For a 22-foot dome, the minimum ceiling height is 13.5 feet and an open floor space 27 x 27 feet is needed—a gymnasium, large multi-purpose room, cafeteria or on the stage of an auditorium.

Since many rooms are constructed with 10-foot ceilings, quite often, the greatest limit to setting up a portable planetarium in a classroom is insufficient ceiling height. Because the dome of a portable planetarium is an air support structure, it is possible to set it up in a room with a lower ceiling. This will result in the top of the dome being flattened slightly as it rests against the ceiling. As

long as the Portable planetarium isn't flattened by more than about a foot, the images projected inside the dome will appear correct with little discernible distortion. If you do set up a dome so it rests on a ceiling care should be taken that there are no sharp objects on the ceiling like sprinkler heads or light gratings that could damage the dome. In addition, the dome should not be brought near hot light bulbs or radiant heaters. These devices can easily melt right through the top of the dome! Even though it is tempting, the portable planetarium dome should never be set up outdoors. Moisture can damage the fan and projector and direct sunlight on the dome will make it deteriorate faster. In addition, when inflated, the Portable planetarium dome is quite buoyant so even a slight wind will cause it to shift position.

### Floor Surface

Because the portable planetarium dome has no floor of its own, and participants are required to sit on the floor, it is important that the floor surface of the room being used also be considered. Ideally, the portable planetarium should be set up on a carpeted floor. This will not only provide maximum comfort for the participants, but it will reduce the wear on the dome fabric. A wood or tile floor can also be used but these are hard and often cold. When setting up on this type of floor, individuals can sit on carpet squares or pillows to make it more comfortable. It is strongly recommended that the floor of the room be thoroughly cleaned before the Portable planetarium is set up. Grit and dirt on the floor can cause damage to the dome when you are setting it up and taking it down. Another option would be to place gym mats, a large canvas or piece of carpet to cover the floor beneath the dome.

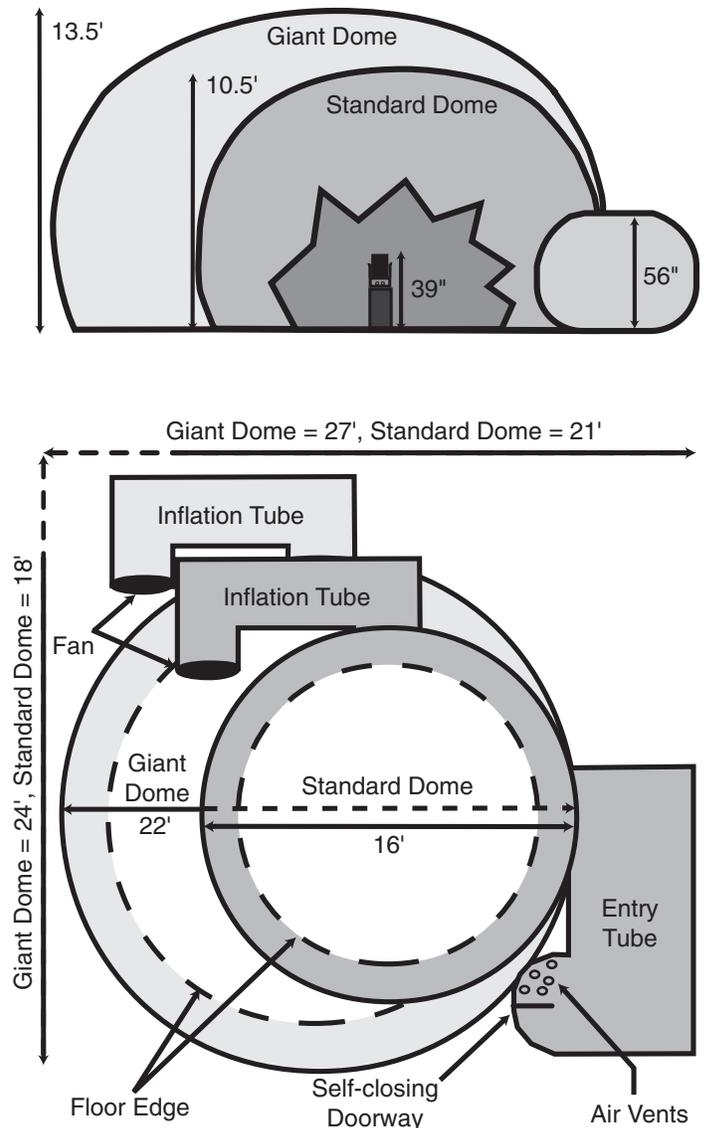
### Electrical Requirements

A reliable source of electricity is essential to keep both the projector and the fan running at all times when the portable planetarium is being used. Most fans and projectors are designed to plug directly into a standard 120 volt, 60 cycle grounded AC outlet although many people prefer to plug them into an outlet strip attached to a heavy-duty extension cord.

If the fan stops for any reason, the dome will not collapse at once, but will start to deflate slowly. There is plenty of time for the teacher or an assistant to make a quick check to see if the fan is plugged in and turned on.

If the fan cannot be turned on again, it is best not to have the class attempt to leave through the exit tube because the air flow through the tube will cause the dome to deflate more rapidly. To quickly get the students to safety, execute the maneuver described below or in “Emergency Procedures” on page 8:

- Have all students move towards the center of the dome.
- Grasp the edge of the dome fabric on the side opposite the entrance and inflation tubes.
- Lift the edge of the dome fabric up to chest or head level.
- Once in motion, the dome will effortlessly continue its motion until the whole thing is bunched up between the two tubes and the class is safe.



## **Other Set-up Considerations**

### **Temperature**

The portable planetarium has no climate control of its own, so whatever the room temperature is will be the temperature inside the dome. Because the fan keeps the air circulating continuously through the dome, it is usually several degrees cooler inside the portable planetarium than out. Even so, in very hot climates, it is best to set up the portable planetarium in an air-conditioned room.

### **Noise Level**

While the portable planetarium dome is completely light proof, sound can travel right through the material. As a result the system should not be set up and used in a noisy environment. People in the room outside the dome should be asked to remain quiet so they don't disrupt the program inside the Portable planetarium. Whenever possible, the portable planetarium should be set up in a room that can be closed off from other classes so that they don't interfere with each other. Never attempt to set up the portable planetarium at one end of a gym when classes are going on at the other end unless the two sections can be separated by a moveable solid wall.

### **Set-up Time**

While an experienced user can usually set up a portable planetarium in less than 15 minutes, it is best to allow a full half-hour to unpack and put up the dome. Once it's connected to the fan, the standard dome will take about 5 minutes to inflate (about 10 minutes for the giant dome). Students who have never seen the portable planetarium before are often excited to watch the set-up process. In general though, it is usually a good idea to set up the portable planetarium before the class is brought into the room. Deflating the dome and re-packing takes about 20 minutes total.

### **Safety Rules**

In order to maximize the overall quality of your portable planetarium experience, and make certain that the system components are not damaged in any way, it's important that you always follow these simple safety rules when using a portable planetarium system.

1. Never set up the dome near an open flame or point heat source such as an incandescent light bulb or a radiant heater. These can easily melt the dome fabric. Never allow anyone who is smoking in or near the dome.
2. Never allow food or drink inside the dome. These can make the inside of the dome sticky and also cause damage to the projector and projection cylinders.
3. Never leave projection cylinders lying loose on the floor when they are not in use. These should always be stored in either the cylinder or projector case.
4. Never set up the planetarium outdoors. It is not designed to be exposed to moisture and direct sunlight, and even a gentle breeze could move the dome when it is inflated.
5. Never allow a group of students to be alone in the planetarium. The instructor should always be the first one in and the last one out. Upon leaving the planetarium dome, the instructor should check to make sure that there is no one remaining in either the entrance or inflation tubes.
6. Always make sure that there is a clear path out of the planetarium in the event of an emergency. Never set up the dome so that it is on the edge of a stage where individuals might fall off. Always show occupants that they can quickly exit underneath the dome wall in the event of an emergency. Do not use the entrance tunnel to evacuate the dome in the event of an emergency.

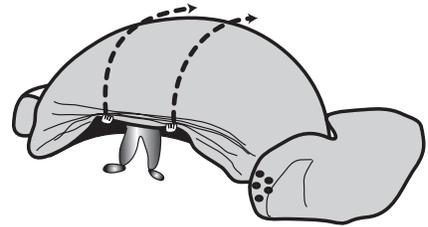


Inside the Portable planetarium dome viewing the Greek Mythology Cylinder

## ***Emergency Procedures***

The instructor should always have a working flashlight at hand in the event of a power failure in the planetarium. If the lights go out, shine the flashlight straight up at the middle of the dome to illuminate the planetarium. Should the fan stop working, the an inflatable dome will not collapse quickly, but will slowly start to deflate. As a result, this will give you time to have someone make a quick check of the fan to make sure that it is plugged in and turned on. If the fan cannot be re-started, it will be necessary to evacuate the dome as quickly as possible. Instead of exiting via the entrance tunnel, have the visitors exit using the following emergency evacuation procedure:

- Have all visitors stand up and move toward the center of the dome. If you are using carpet squares, have each person pick up the one they are sitting on.
- Grasp the edge of the dome fabric directly opposite the side of the planetarium where the inflation and entrance tubes enter the dome and lift the fabric up and over the visitors so the dome flips over onto itself. Once in motion, the fabric should continue to bunch up on itself so it falls to the floor between the two tunnels.
- Ask the visitors to duck down and walk quickly under the Portable planetarium through the opening you created. In just seconds, the entire group can be evacuated.



## ***Entering and Exiting the Portable planetarium***

Students should be instructed to enter and exit the dome in a single file line, one at a time. While they do not have to crawl, they should be instructed to “stay low and go slow.” It is always a good idea to have two adults working to assist when students are going in and out of the dome. One adult acts as the “door keeper” on the outside while the second stands inside the Portable planetarium where the entrance tunnel meets the dome. After every three people enter the dome, the “door keeper” should hold the entrance tube closed for about 5 seconds to give the dome a chance to re-inflate. It is also helpful for the person on the inside to have a flashlight or battery powered lantern that he or she can shine in the tunnel to help illuminate the way.

Once inside the dome, visitors should be instructed to sit on the floor on the edge of the fabric in a circle. They should not lean back on the dome fabric because it might cause the dome to be pulled down or to rock excessively. No one should sit in the space directly in front of the fan opening nor should anyone enter the inflation tube. If there are more people than a single circle can

accommodate, then visitors can make a second inner circle surrounding the projector. Because a portable planetarium usually does not have any seats, one suggestion is to lie out carpet squares on the floor before the visitors come into the dome. In addition to providing some comfort, the carpets help to define specific seats, which is particularly helpful for younger visitors.

When it is time to exit the dome, the door keeper should leave first and hold the dome entrance open for the group to exit. Visitors should exit single file being careful not to trip over the fabric at the end of the entrance tunnel when they leave.

## ***Accommodating Visitors Who Are Physically Challenged***



Many portable planetariums can accommodate visitors who are restricted to wheelchairs, have walkers or are otherwise physically challenged. Some have doorways large enough or expandable to allow a wheel chair to pass through. As last resort, a wheelchair can brought into the dome by lifting the edge or the dome. This technique should be done before the rest of the visitors enter. Turn up the fan to the highest setting so that the dome becomes over-inflated and starts lifting off the floor. Remove carpet squares from inside the dome and maneuver the individual to the side of the planetarium directly opposite the point where the entrance and inflation tubes enter the dome. With the help of a second person, lift the side of the dome and roll the person in the wheelchair under the material toward the center of the dome, next to the projector. Drop the side of the dome back down behind the person and allow the dome to reinflate. Once the dome has fully reinflated, turn the fan back to low. Bring the rest of the group into the planetarium. When the program is over, allow the rest of the group to leave and then exit the person in the wheelchair the same way that you brought them in—under the side of the dome.

# Setting Up a Portable Planetarium System

## The Planetarium Dome

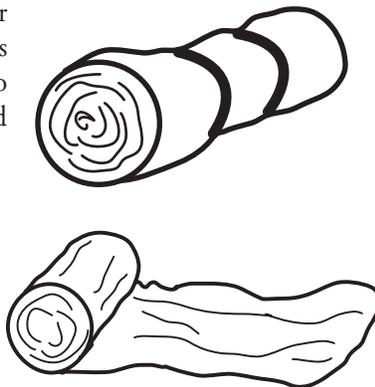
### Before Unrolling the Dome

1. Select the room that you're going to use and check the electrical outlets that you are planning on using to make sure that they are live. Test them by plugging in and turning on the fan. Although an extension cord is not needed, you may want to have one with an outlet strip in order to make it easier to plug in the projector and fan. Make sure you have adequate space to set up the dome and that you are not near the edge of a stage or blocking a fire exit.
2. Decide where you want the entrance and inflation tube to be located. In making your decision, try to envision the traffic pattern that will be created in the room once people start entering and exiting the dome.
3. Make certain that the floor that you will be setting the dome on is clean and free of grit which can cause holes when the dome is unrolled. If you are going to use a temporary floor covering such as a tarp, rug or gym mats, spread them out on the floor before unrolling the dome. Some teachers have their visitors remove their shoes.
4. Before setting up the dome, unpack the planetarium projector and plug it in to make sure that it works properly. Once the projector has been checked out, place it off to the side and proceed with setting up the dome.

Projection systems vary from manufacturer to manufacturer. Refer to their operation manuals for details on how to set up a portable projection system

### Inflating the Dome

1. Remove the dome from its.
2. Start unrolling the dome across the floor where you are planning to set it up. As you unroll it, spread out the material so that you can identify the entrance and inflation tube.
3. Once the dome has been completely unrolled and spread out, turn it so that the entrance and inflation tube are in the positions that you have pre-selected. When turning the deflated dome, try to minimize the amount that it is dragged along the floor. Dragging the dome can cause small holes to develop in the dome material.
4. Plug in the fan, either directly into the wall or into a heavy-duty extension cord. Test the fan to make sure the outlet is working and then bring it over to the opening of the inflation tube. Attach the fan to the inflation tube.
5. After the fan has been secured to the dome, turn it on high. As the dome begins to inflate, walk around it lifting it slightly until it starts to take a circular shape. Make sure



that the two tunnels are not twisted or folded and that the edge of the fabric inside the dome is completely flat against the floor. You can speed up the inflation process by holding the entrance tube closed so no air comes out. Once the dome is completely inflated, the entrance tube will close automatically.

7. Once the dome is completely inflated, it will begin lifting off the floor slightly. Turn the fan down to medium or low. This will keep the airflow at equilibrium. Both the inflation and entrance tubes have two right-angled bends in them. This is to prevent light from leaking into the dome. Walk around the outside of the dome and make sure both of these tunnels are “squared off”. It is also important that the back of the fan be set back at least 18 inches from the dome material. If the fan is too close, the fabric of the dome can block the airflow causing the fan to overheat and the dome to collapse. It is a good idea to place the empty fan box in between the inflation tunnel and the inflated dome to serve as a buffer in case the dome drifts when the program is taking place.

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# ***Taking Down and Packing Up the Portable Planetarium System***

## ***The Portable Planetarium Projector***

After you have completed your planetarium presentations for the day, it's time to break down and re-pack the planetarium back into its cases. Store all items in their proper places. Exit the dome and turn off the fan. The dome will begin to deflate. After it has dropped about 3 feet, go to the side of the dome opposite the inflation tube and perform the "emergency exit" maneuver: lift the material about 5 feet off the ground flipping it back toward the opposite side of the dome. If you do this quickly enough, the dome will ride back on the air that was trapped inside forming a crescent shaped pile of fabric on the floor. Allow the dome to sit for a few minutes so that the remaining air flows out of it while you continue packing up the projector and fan.

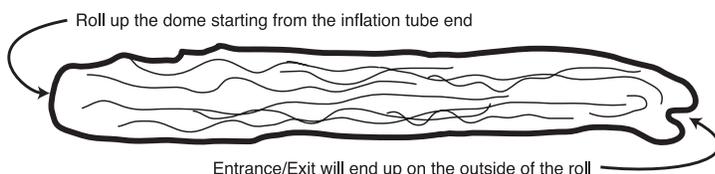
Unplug the fan from the power outlet, disconnect it from the inflation tube, and put it away.

Unplug the projector and finish packing.

## ***Rolling and Packing an Inflatable Dome***

While the Portable planetarium dome can be rolled in many different ways, the following procedure is usually found to work best.

- 1) Once the dome has been flipped over and deflated, it should look like a large crescent shape on the floor.
- 2) Fold the inflation tube over so it lays flat on the rest of the dome material, then fold it in half lengthwise over on itself, twice if necessary. The dome material should now have a near perfect crescent shape.
- 3) Walk along the length of the crescent pushing the edges in so that the width of the material is about 3 feet (1 meter). Do not make it too narrow or wide because it will not fit back into the dome bag. Start rolling up the dome like a sleeping bag from the inflation tube end. Remember, the tighter you start to roll, the easier it will fit into the bag! Pause every few rolls to let any
- 4) trapped air out. Kneeling or sitting on the dome will help to push the air out.
- 5) Once the dome has been completely rolled up, unzip the dome bag and drape it over the top of the rolled up dome. Roll the dome over so the bag is now underneath and carefully zip the bag closed making sure NOT to catch any of the material in the zippers! Store the dome in a cool dry place. Do not store it in an unventilated closet or room that is damp because the canvas bag may get moldy.



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## ***Routine Maintenance of the Portable planetarium***

While a portable planetarium planetarium system is well constructed and stands up well to repeated use, it does occasionally need some routine maintenance to keep it operating in top form. Here are the basic maintenance procedures that should be done on a periodic basis.

### ***Dome***

While the dome material is quite durable and does not tear easily, it can get small punctures that allow light to shine through from the outside creating extra “stars” in the sky. These holes can be patched using peel-off, adhesive-backed dome patches found in the yellow accessory box. To patch the dome, in a brightly lit room deflate it by lifting the side to let out just enough air to lower the “ceiling” to a reachable height. Turn off all the lights inside the dome and look for the pinholes. Once you have located them, peel and stick the patches onto the dome from the inside so they completely cover the hole.

### ***Projector***

Every projection system is different. Refer to manufacturer’s instructions for maintaining the projector. For system with projection cylinders, the cylinders are made from film and need to be handled with care. Any dents in the cylinder should be removed as soon as possible by applying light pressure on the outside of the cylinder around the dent. Normal fingerprints on the outside of the cylinder will eventually degrade the projections. Cylinders should be treated like photographic film—they can be cleaned with distilled water and a soft LINT FREE cloth but NEVER use any type of soap, solvent or window cleaner! When the outside of the cylinder is damp, it is extremely tacky. Lint, dust and dirt can easily stick to it permanently damaging the cylinder.

### ***Fan/Blower***

After several months of use, dust and dirt will build up on the fan blades and motor. This can easily be removed by vacuuming the motor with a soft brush attachment.

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## **Tips from Teachers**

Over the years, literally thousands of teachers have used portable planetariums. Many of these teachers have come up with unique “tricks” that help to enhance the planetarium experience. The following is a compilation of some of these helpful hints. Since they are not arranged in any particular order, you may want to review all of them for possible relevance to your own situation.

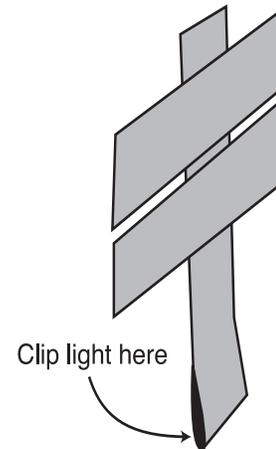
### **Let There be More Light**

There are many occasions when you might need additional lighting in the planetarium. In order to perform activities like reading starmaps and completing worksheets, it is very helpful to use an auxiliary light source. One system that works well involves using one or more clamp-on photo lights plugged into tabletop or hand-held dimmers. Both the lamps and the dimmers are available at most hardware and home improvement stores. The clamp-on lamps should have reflectors to direct the light downward to provide light for reading and writing. This allows the stars to still be seen in the sky while the lights are on. One light can be positioned with the reflector pointing upward for general room lighting and for simulating the Sun. These additional lights also make it easier for visitors to see when they enter and exit the dome. The auxiliary lights can be clamped directly to the top of the projector stand or to a board placed under the projector that hangs over the side of the stand. Using the dimmer allows you to adjust the light to the proper level for each activity and it's best to use forty-watt bulbs.

You can vary the arrangement of clamp-on lamps and the color of the light bulbs to suit the needs of the particular lesson that you are conducting. With a blue bulb and the reflector pointing upward, you can simulate a daytime sky. To make it easier for your students to read while they are in the dome, you can use a red bulb with the reflector pointing down. By carefully adjusting the brightness of the bulbs, students will be able to see starmaps and worksheets and preserve their night vision so they can also see the stars being projected on the dome.

A six-volt camping lamp or lantern is a perfect addition to help provide extra lighting in the tunnel when people enter and exit the dome. By placing it on the floor at the inner end of the tunnel, people can be directed to “walk toward the light” without tripping over the material or wires. Adding an opaque top cover to these types of lamps turns them into an excellent reading lamp for you to use as well.

**Flap Made of Duct Tape**  
(for hanging lightweight  
lights on the dome)



Many experienced planetarium users have experimented with far more complex lighting systems that usually involve hanging small lights from the dome itself. Some variations of this include using Christmas tree lights, tube lighting (as found along aisles in movie theaters), or 7-watt bulbs in lightweight, clip-on sockets with small metal reflectors. Extension cords can be plugged into a tabletop or hand-held dimmer, extended out to the light positions and taped to the floor to prevent people from tripping over them.

Lights can be attached to the dome either by Velcro or by flaps made from strips of duct tape. The duct tape is folded over so that most of the tape sticks to the dome wall, but leaving a 2 to 3 inch long flap hanging down. Two more strips of duct tape placed horizontally over the first piece adds more strength to the attachment. An optimal height for securing the flaps is about 1.3 meter (4 feet) above the floor. (See illustration on the previous page.)

## Leaving Your Mark

For many activities, it is useful to mark positions as reference points inside the planetarium. You may wish to mark the path of the Sun across the sky so that you can compare the angle of insolation on a winter and summer day. You may also want to have students predict and mark the position of the sunrise and sunset points for different days of the year or mark the position of different constellations as they appear to move across the sky. In small portable planetariums, it is possible to mark all of these things using Post-it™ style notes or index cards backed with doublestick masking tape. Students can write their names right on the labels and attach them directly to the inside of the dome. Using this same technique, you can also label the cardinal directions using cards that have the letters written in day-glow or phosphorescent paint.

Alternatively, you can use cardboard markers or other signs attached directly to the dome with Velcro. In permanent facilities, markers can hang from the edge of the dome by hooks or Velcro.

## Pointers

For some activities, you may wish to have more than one pointer available for use. You can divide the group into teams for example, with each team being given a pointer. To help differentiate between the different pointers, you can use pointers with different images such as a lightning bolt, a finger or several different shaped arrows. Instructions for making an inexpensive LED pointer can be found on the PASS website (<http://lhs.berkeley.edu/pass>) in the *Constellations Tonight* News/Updates area.

## Shoot the Moon

In presenting a lesson on the phases of the moon, you may want to show the phase of the moon for different days of the month. In some planetariums, this may require you to simply align and then turn on a separate moon projector. In a STARLAB, you must attach moon discs over the proper holes in the Starfield Cylinder. This is not easily done in the dark during a lesson. A simple solution to the problem is to attach all the necessary moon phases before beginning the activity and then cover the moons that are not being used with small (1") Post-it™ notes. In this way, all of the moon phases will be in proper position beforehand, but they will not be visible until you remove the Post-it™ note.

## Making Order from Chaos

Placing carpet squares on the floor to establish a seating pattern helps to make things more orderly for classes entering the planetarium. Not only do these pads help to define each student's space, but they also make sitting on a cold, hard floor a bit more comfortable. Carpet squares can usually be gotten from large carpet stores that use them as samples. Quite often, they will donate old samples to schools and other educational establishments. When they do charge for them, they usually cost about a dollar or two each. One typical seating pattern is shown in the diagram at right.

### A Great Resource for Educators . . .

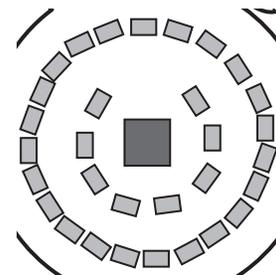
The International Planetarium Society (IPS) has a Portable Planetarium Committee whose purpose is to help those interested in the use of portable planetariums and to provide a support system to assist portable planetarium users.

The committee maintains resources including a database of users and specialists, curriculum and lesson materials including the TIPS Booklet and CD, current mobile planetarium manufacturers, and low-cost special effects. In 1995 the committee co-sponsored the first European Meeting of Itinerant and Small Planetaria in Lumezzane, Italy, and is currently cataloging its resource materials, preparing a proposal for a publication of educational materials suitable for use in portable planetariums, and seeking contact people in each regional affiliate.

See:

[www.ips-planetarium.org](http://www.ips-planetarium.org) or  
[www.ips-planetarium.org/ips-portable.html](http://www.ips-planetarium.org/ips-portable.html)

The chair of the committee is Susan Reynolds Button. E-mail: [sbutton@ocmboces.org](mailto:sbutton@ocmboces.org)



## ***Hold the Pencils***

For many activities in the dome, it's helpful for students to have something to write with. Unfortunately, pencils and ballpoint pens can also have a down side to them. When students are entering and exiting the dome, carrying sharp pointy objects can be somewhat dangerous. In addition, while it doesn't happen often, students armed with these devices can do damage to the dome by poking holes in it. If pencils are going to be used inside the planetarium, it's a good idea for you to have a class set that you hold and distribute inside the dome and then collect before the students leave. A better idea would be to have a class set of felt-tip markers. Vis-à-vis pens can be found in stores that stock office supplies. Color is not an issue since all marks made on paper appear fairly dark in the planetarium. Marks on the dome can easily be wiped off. The pen tips are hard enough for average writing but too soft to damage the planetarium. While these make erasing a bit more difficult, they never need sharpening and they make it far more difficult to put extra stars in the Portable planetarium dome!

## ***There's No Place like Dome***

The portable, inflatable dome is a marvelous invention, and here are a few tips to make it even easier to use with students. First, when students are entering the dome, do not keep the flaps to the entrance tube wide open. Too much air will escape and the dome will quickly deflate. It is better to let students go into the entrance tube two or three at a time, then close the flaps for a few seconds to keep too much air from leaving the dome. Repeating this procedure will allow everybody to get in quickly, yet it will help maintain the inflation of the dome. Also, it is wise to keep the fan on "high" while people are entering the dome and then turn it back to "medium" or "low" once everyone has taken their seats.

Over the course of a day, the dome has a tendency to shift its position on the floor. This usually does not cause a problem but it could make the projector drift off center after a while. In order to minimize the amount of distortion in the projections, it is important that the projector be set up directly under the center of the dome. Each time a group exits the Portable planetarium, it's a good idea to go back outside and re-align the dome to its original position. Making sure that there are no kinks, deep wrinkles, or bends in the inflation tube can reduce the amount of dome shift. Placing carpet squares along the inside edge of the dome will help to weigh the dome down which also reduces drift. Under no circumstances should you ever tape the bottom of the dome to the floor. This will make it difficult to lift the dome in the event that an emergency evacuation is needed!

## ***Keep the Stars out of Their Eyes***

In some instances, it's desirable to have the starfield projector mounted higher up so that the horizon/stars do not shine in the viewer's eyes. (This is especially true with older students who are taller.) When this is the case, before setting up the projector and the stand, lay the lid of the projector case face down in the middle of the floor and then set up the stand on top of it. This will elevate the horizon by about 6 inches, which usually keeps the stars out of the eyes of taller students and prevents you from casting as big a shadow on the dome behind you.

## ***Creature Comforts***

A whole day of teaching in the Portable planetarium can be grueling. Little amenities can help a great deal. For example, if you like to operate the projector from your knees, a set of gardener's knee pads helps a lot. A short stool (camping stool) or kindergarten chair can also be used if you prefer to sit up. If you like to sit on the floor, a stadium chair that is really a cushion with a back support works wonders. When all else fails, you can always use a pillow. Having throat drops and a sport bottle filled with water also helps preserve the throat. Take frequent drinks and don't forget to stretch!

## ***Empowering the Educator***

### ***Portable Planetarium Teacher Training and Rental Program***

How can a science museum most effectively educate young people about the universe? The traditional way is for students to go to a planetarium star show or for a museum staff member to conduct a special program at the school. While these methods are great for exciting a student and igniting their curiosity, it may not always be effective for learning about the universe and it most certainly does not aid in the professional development of the educator.

Many students have had a positive experience when they sit in a large auditorium, filled with hundreds of other kids and listen to a booming voice talk about the heavens and the stars with mysterious music playing in the background. However, at this point, many have questions and are ready to have a dialogue about what they saw and heard. It is at this stage that the educator needs to take control of the situation and harness the excitement brimming within and among the students. What better way to expand on the planetarium experience than by a teacher running his or her own personalized planetarium shows right in their schools!

The New York Hall of Science has developed the Portable planetarium Teacher Training and Rental Program that has been in operation since 1988. Through this program, teachers receive anywhere between three to four days of training in the use of Portable planetarium Kit. They then rent the kit, which includes Portable planetarium, any expendable materials like light bulbs, flashlights, extension cords and a curriculum guide for use in the classroom at drastically lower costs that it would be to make the initial investment for this equipment.

The Portable planetarium Teacher Training and Rental program effectively and efficiently meets several critical needs in the schools by providing teachers with:

- science content knowledge in the areas covered by the kits
- pedagogical skills in teaching science through hands-on, inquiry based activities
- state of the art equipment for which the schools may have neither the capital budget, nor the resources for maintenance
- confidence in teaching skills.

Most participants have had little or no background in astronomy. The Hall of Science training course is designed to address the teachers' anxieties and fears and models a variety of topics for teachers, including constellations and star maps, lunar phases, the reasons for seasons and retrograde motion. Mythology is also introduced and teachers are

The accompanying article was written by Preeti Gupta, Director of Education at the New York Hall of Science in Queens, New York for this updated version of PASS Volume 4.

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familiarized with all the different cylinders available for use with Portable planetarium. Portable planetarium lessons coupled with kinesthetic modeling is key to much of the baseline concepts introduced during the four-day course. Hands-on activities are conducted to provide teachers with pre and post rental ideas. Teachers also work in groups to design their own Portable planetarium lessons so that they become comfortable with Portable planetarium as a tool and in addition to conducting lessons that we model, they are able to be creative and utilize Portable planetarium for their personal pedagogical needs. Standards correlation, classroom management strategies and assessment tools are also discussed.

Teachers who are trained and use one of the Portable planetarium kits have reported that they have become the “favorite” teacher in the school and in fact the students remember this experience year after year and look forward to entering the “the bubble thing.” With Portable planetarium, teachers can custom-make their lessons for their students and modify the lesson as it progresses to suit the learning styles of the students. With Portable planetarium, the lights can be turned up at any point to invite commentary or to create a stronger dialogue on the different topics of astronomy. Portable planetarium teachers frequently continue to attend other training programs at the New York Hall of Science. These teachers become resources for their schools, encouraging other teachers to participate in the program and creating informal teacher networks for support and training. Many participants become more confident in their abilities to teach hands-on science, and return to rent Portable planetarium year after year. Trained teachers often return for a one-day refresher course so that they can review certain technical skills, but also learn new lessons to present to their classes.

Although programs such as this do need grant support for initial development and equipment, a model such as this does become self-sufficient through training and rental fees. The New York Hall of Science owns and circulates eight Portable planetariums. Twenty-one science museums have replicated the training and rental model through funding from the National Science Foundation for the Portable planetarium Kit.

Through anecdotal evidence and evaluations conducted on both the Hall of Science Portable planetarium Teacher Training Program and the Portable planetarium Rural Replication Program, it is clear that programs such as this provide many benefits. Empowering the teacher to feel comfortable, confident and competent on a particular science topic and related technologies not only rejuvenates them to teach, but also inspires an interest in programs offered by other informal learning centers. For administrators who are unable to make a Portable planetarium purchase, renting the equipment is an ideal situation that can serve many students each time a different teacher uses it.

**To learn more about the Teacher Training and Rental Program, contact Preeti Gupta, Director of Education at the New York Hall of Science, 47-01 111 Street, Queens, NY 11368, [pgupta@nyscience.org](mailto:pgupta@nyscience.org).**

The logo for INTERACT! PASS Classic features the word "INTERACT!" in a large, bold, sans-serif font. Each letter is filled with a different color: 'I' is black with a white dot, 'N' is purple, 'T' is blue, 'E' is orange, 'R' is yellow, 'A' is blue, 'C' is light blue, and 'T!' is red. A small black square is positioned below the exclamation point. Below "INTERACT!" is the text "PASS Classic" in a smaller, blue, sans-serif font.

**INTERACT!**  
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