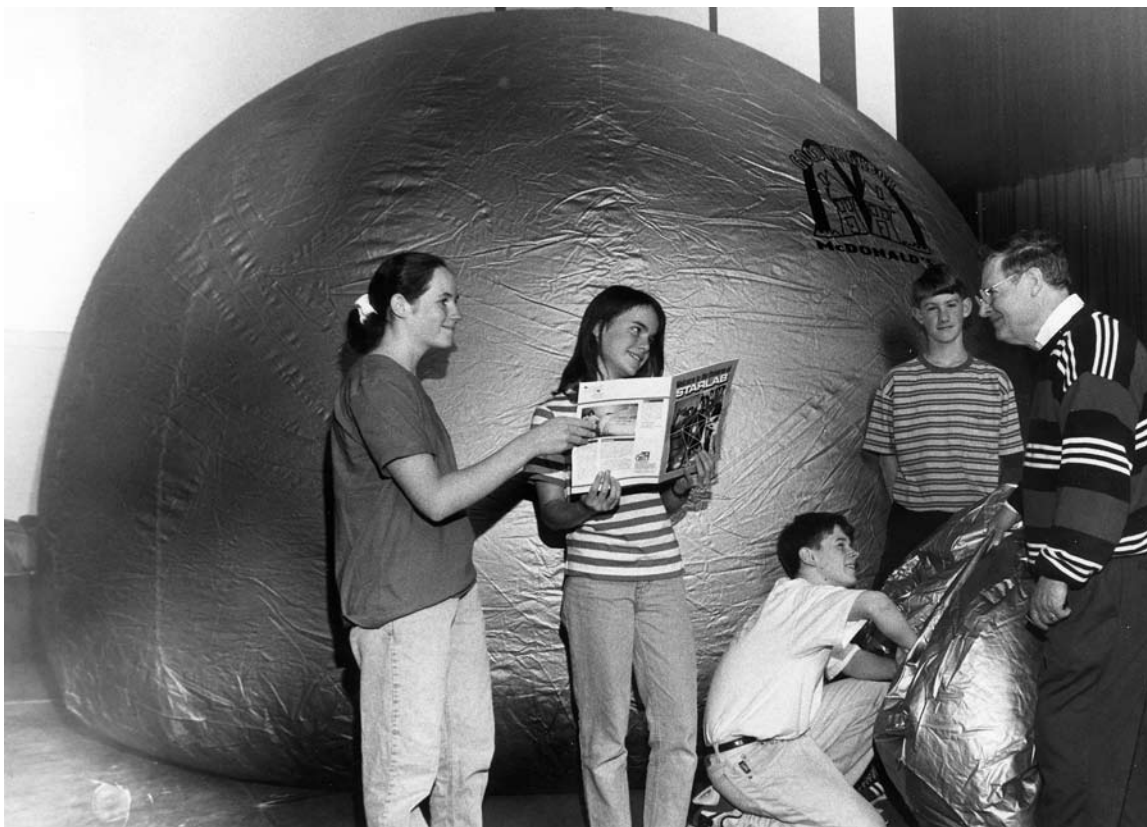


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# ***STARLAB***

## ***Portable Planetarium System***



***— Part A —***

## ***Set-up, Operation and Maintenance***



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**Welcome aboard  
and keep the stars  
in your eyes!**

## ***Getting Started***

### **Introduction**

Thank you for your purchase of the STARLAB Planetarium System. We welcome you to a growing family of educators who have come to appreciate the versatility and excitement inherent in the STARLAB system. In this section, you will be provided with all of the information needed to successfully set up and operate the STARLAB Portable Planetarium System. In addition, we've included a number of maintenance tips, which will keep your STARLAB system in peak operating condition for years to come.

The staff of Science First/STARLAB is not only committed to providing you with the finest equipment available, but with the highest quality service possible. We are always looking for ways to improve our products and service and we would love to hear from you. If you have specific questions, please contact us using the information below.

#### **Science First/STARLAB.**

40 Cameron Avenue • Somerville, MA 02144 • USA  
Phone: 1-800-537-8703 (U.S. and Canada only) or 1-617-628-1459  
Fax: 1-617-628-8606 • E-mail: [starlab@starlab.com](mailto:starlab@starlab.com)

In order to keep informed about our latest products, we invite you to log onto our Web site:

**[www.starlab.com](http://www.starlab.com)**

## Safety Rules

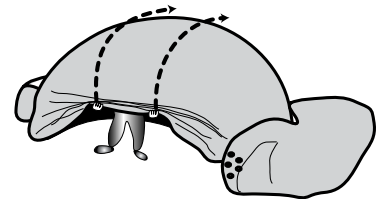
In order to maximize the overall quality of your STARLAB experience, and make certain that the system components are not damaged in any way, it's important that you always follow these simple safety rules when using the STARLAB System.

1. Never set up the STARLAB dome near an open flame or point heat source such as an incandescent light bulb or a radiant heater. These can easily damage the dome. Never allow anyone who is smoking in or near the dome.
2. Never allow food or drink inside the STARLAB dome as it could make the inside of the dome sticky or could 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 STARLAB 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 STARLAB. The instructor should always be the first one in and the last one out. Upon leaving the STARLAB 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 STARLAB 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 (see below). Do not use the entrance tunnel to evacuate the dome in the event of an emergency.

## Emergency Procedures

The instructor should always have a working flashlight at hand in the event of a power failure in the STARLAB. If the lights go out, shine the flashlight straight up at the middle of the dome to illuminate the STARLAB. If the fan stops working, the STARLAB 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 restarted, 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 STARLAB where the inflation and entrance tubes are located. 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.
- In just seconds, the entire group can be evacuated.



- 1 Projector
- 2 Projector/Cylinder Travel Case
- 3 Projection Cylinders
- 4 Dome Duffel Bag
- 5 Blower
- 6 Blower Travel Case
- 7 Astronomy and More Curriculum Manual
- 8 Planetarium Activities for Student Success (13 volume set)
- 9 Slide Set of the Planets, Stars and Galaxies
- 10 LED Arrow Pointer
- 11 Accessory Box with replacement bulbs, planet set, moon set.
- 12 Tours of the Night Sky (tapes and CD)
- 13 STARLAB Newsletter



### **Packed Standard Dome**

Dimensions: 36" x 18" diameter  
(91.4cm x 45.7cm)

Dome Weight: 45 lbs

Contents: Fabric Dome inflates to 16' dia. x 10.5' high (4.88m x 3.2m)

Seating Capacity: 25–35 people

### **Packed Giant Dome**

Dimensions: 46" x 23" diameter (1.2m x 58.4cm)

Dome Weight: 90 lbs

Contents: Fabric Dome inflates to 22' dia. x 13.5' high (6.71m x 4.11m)

Seating Capacity: 60+ people

### **Projector Case**

Dimensions: 31" x 26.5" x 17" (79cm x 67cm x 43cm)

Weight: 40 lbs

Contents: Projector and 2 cylinders, box of accessories, manual

### **Fan Case**

Dimensions: 25" x 25" x 10" (63.5cm x 25.5cm)

Weight: 20.5 lbs

Contents: Fan

## **The STARLAB Portable Planetarium System**



The STARLAB Planetarium System consists of an inflatable dome, (which comes in two sizes), a projector and a high volume fan that is used to inflate the dome. The Standard STARLAB Dome is 16 feet (4.8 m) in diameter and has a ceiling height of 10.5 feet (3.2 m). It can easily accommodate 25 adults or 35 elementary-age students. The Giant STARLAB Dome is 22 feet (6.7m) in diameter, has a ceiling height of 13.5 feet (4.1 m), and has a seating capacity of 60 adults.

When the STARLAB is packed for transport, the basic system is contained within two hard cases and a large duffel bag. One person can carry each component and the entire system will fit into most medium sized cars. In fact, the STARLAB system is so compact that most airlines will accept it as regular baggage.

## **Before Setting Up The STARLAB**

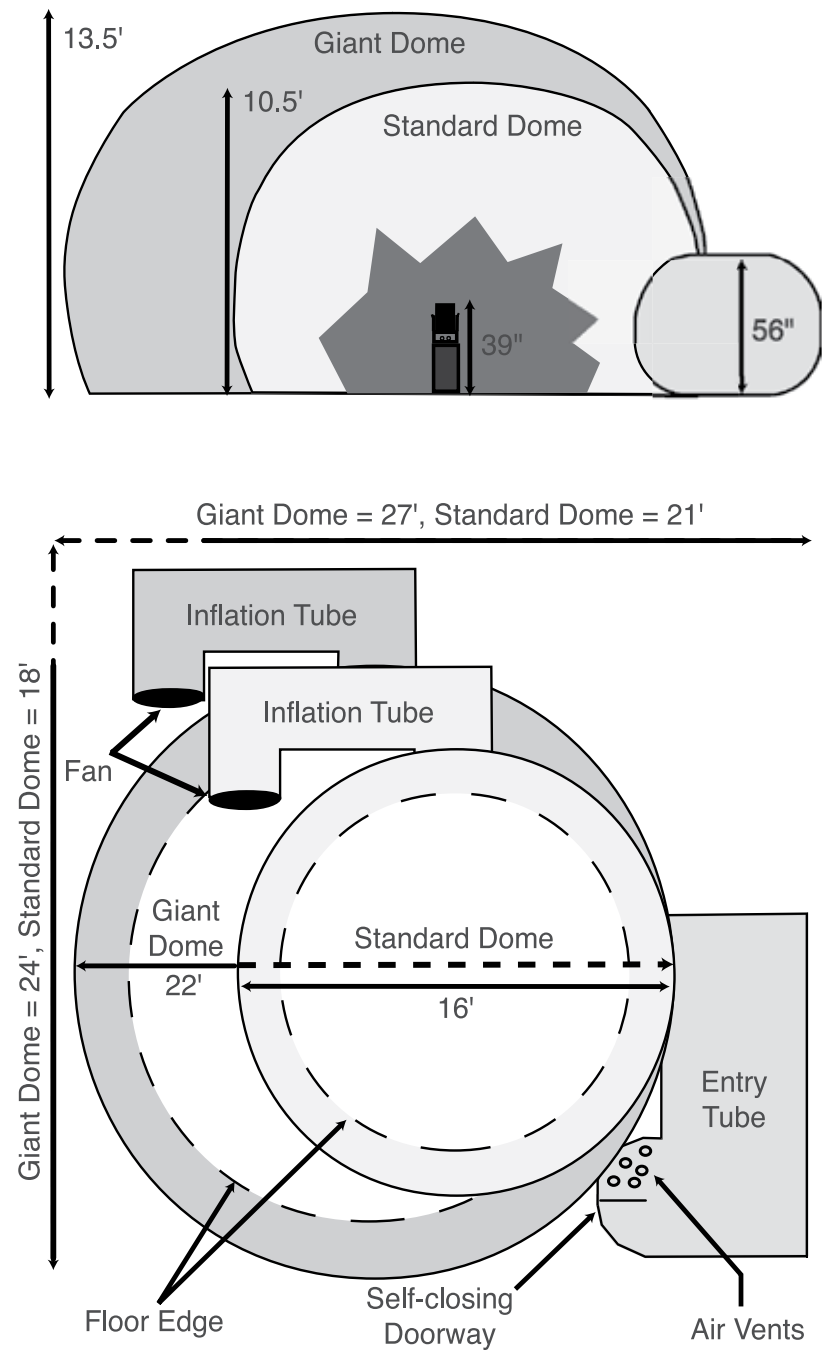
### **Room Requirements for Using the STARLAB**

The type of room that you select to set up the STARLAB Planetarium will depend on which of the two domes is being used. For the Standard (16-foot) Dome, a minimum ceiling height of 11 feet is needed with a cleared square floor space of 21 feet. The Standard Dome can fit into most classrooms that have had the desks and chairs removed or on the stage of an auditorium. For the Giant (22-foot) Dome, the minimum ceiling height is 14 feet and an open floor space of 27 x 27 feet is needed. As a result of these bigger dimensions, the Giant Dome is most often set up in a gymnasium, large multipurpose room, or cafeteria.

### **Note**

*Although many rooms are constructed with a 10-foot ceiling (slightly lower than the dome), it is still possible to set up STARLAB because of the dome's*

air-supported structure. This will result in the top of the dome being flattened somewhat as it rests against the ceiling. As long as the STARLAB isn't flattened by more than about a foot, the images projected inside will appear correctly with little discernible distortion. If the dome must rest on a ceiling, just be careful that it does not come into contact with any sharp objects like sprinkler heads or light gratings that could damage it. In addition, the dome should not rest on or near hot light bulbs or radiant heaters which can damage the dome fabric. Though tempting, the STARLAB 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 STARLAB dome is quite buoyant so even a slight wind will cause it to shift position.







## **Preparing the Floor Surface**

Because the STARLAB dome has no floor of its own, and participants sit on the floor, it is important to consider the floor surface. Ideally, the STARLAB should be set up on a carpeted floor. This provides maximum comfort for the participants, and reduces wear on the dome fabric. A wood or tile floor can also be used but these are hard and often are 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 STARLAB 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 is to place gym mats, a large canvas or piece of carpet to cover the floor beneath the dome.

## **Electrical Requirements for Using the STARLAB**

A reliable source of electricity is essential to keep both the projector and the fan running at all times when the STARLAB is in use. The standard STARLAB fan and projector are designed to plug directly into a regular 120 volt, 60 cycle grounded AC outlet. Special order 230 volt, 50 cycle models are also available from LTI. The voltage of your projector and fan are clearly marked on the back of the equipment. The STARLAB projector does not have any accessory power outlets so if you want to use any additional equipment such as slide projectors, tape recorders or reading lamps, it will be necessary to have a separate power cord with an outlet strip inside the dome.

## **Temperature**

The STARLAB has no climate control of its own, so whatever the room temperature is on the outside of the dome 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 STARLAB than out. Even so, in very hot climates, it is best to set up the STARLAB in an air-conditioned room. If possible, the STARLAB dome should not be set up under skylights or next to windows where direct sunlight can shine on the dome. This may cause the dome to heat up.

## **Noise Level**

While the STARLAB dome is completely light proof, sound can travel right through the material. As a result, the system should not be 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 STARLAB. Whenever possible, the STARLAB 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 STARLAB 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 the STARLAB 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 STARLAB before are often excited to watch the set-up process. In general though, it is usually a good idea to set up the STARLAB before the class is brought into the room. Deflating the dome and repacking takes about 20 minutes total.



## Setting Up the STARLAB Dome

### Before Unrolling the Dome

1. Check the electrical outlets that you are planning to use to make sure that they are “live” by plugging in and turning on the 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. Before setting up the dome, unpack the STARLAB projector and plug it in to make sure that it works properly. (See page 11 for proper procedures). Once the projector has been checked, place it off to the side and proceed with setting up the dome.
3. Decide where you want the entrance and inflation tunnels to be located. Remember the two tunnels are at right angles to each other on the dome. 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. Make certain that the side of the dome opposite the two tunnels is not next to the edge of a stage or dead ending into a wall. This side must be kept clear in the event that you must lift it for an emergency evacuation.
4. Make certain that the floor where you are setting up the STARLAB is clean and free of grit that 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 mat, spread it out on the floor before unrolling the dome.

### Inflating the STARLAB Dome

1. Unzip the canvas duffel bag and remove the dome. The dome should have two luggage straps securing it. Remove the straps and put them back into the bag so that they don't get lost. Zip the bag closed and place it in a safe location where you can find it easily when it's time to pack up the STARLAB.

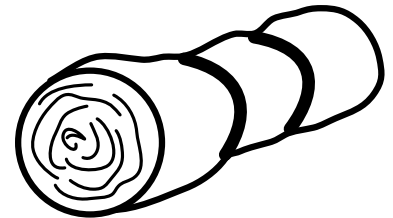
#### Note

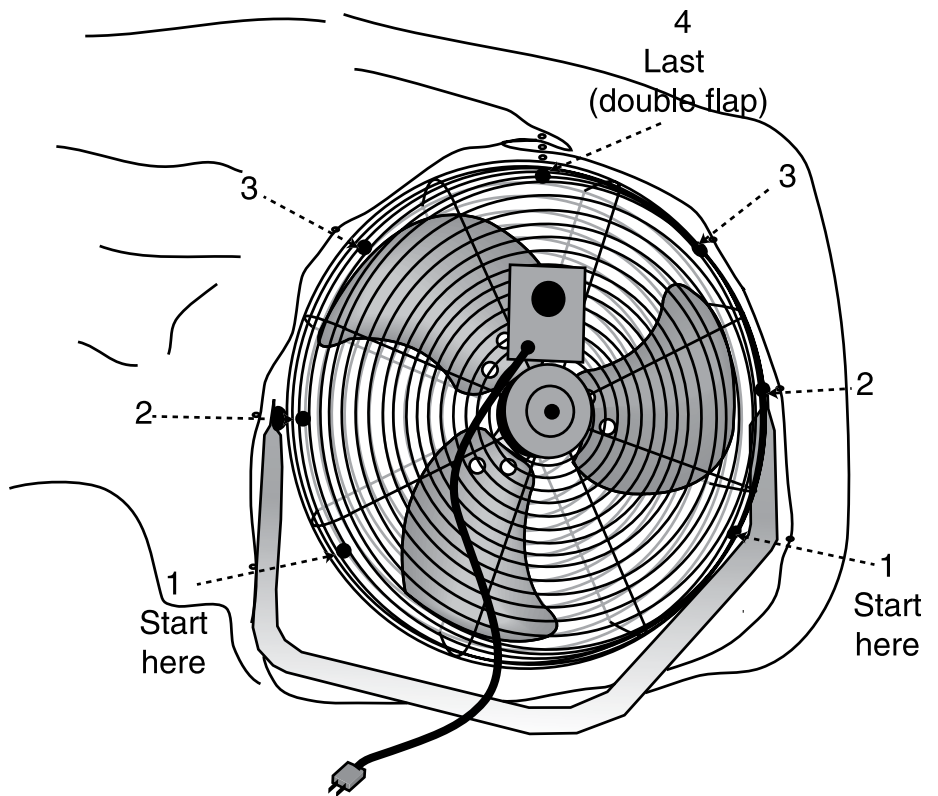
*The fan case is useful for storage once the fan has been removed.*

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 tubes. The inflation tube is the smaller of the two tunnels and has snaps around the opening. The entrance tunnel has the STARLAB logo printed on it.
3. Once the dome has been completely unrolled and spread out, turn it so that the two tunnels are in the positions that you have pre-selected. When moving 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 fabric.
4. After the dome has been properly oriented, remove the fan from its carrying case and plug it in. The fan can either be plugged directly into the wall or into a heavy-duty extension cord. The fan has snaps around the metal protective cage that line up with the snaps on the opening of the inflation tube.

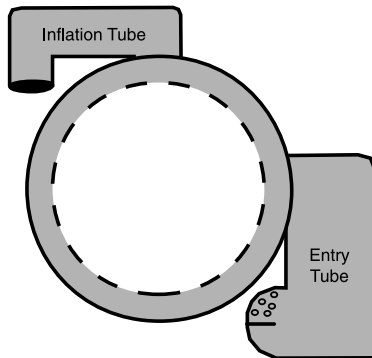
#### Note

*Over the years, the fans have changed. If you have an older system, the exact procedure for attaching the fan to the tunnel may vary. In most cases, a specific diagram should be found in the fan box. The diagram on the next page shows the most recent fan design.*





5. Begin connecting the fan by first attaching the bottom two snaps on the fabric. The bottom snaps are located about 2 feet apart, while all of the other snaps are about 9 inches from each other. After you've attached the bottom snaps, begin connecting the side snaps going up one snap at a time on each side. Finally, attach the single snap on the top of the fan.
6. 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. When the dome is fully inflated, it may begin lifting off the floor slightly.
7. Both the inflation and entrance tubes have two right-angled bends in them 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". Also make sure that the back of the fan is set back at least 18 inches from the dome material.



Make sure that the entrance and inflation tubes are "squared off" to prevent light from entering the STARLAB dome.

**Note**

*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 while the program is taking place.*

## ***STARLAB Standard Projector***



### **Unpacking and Setting Up the Standard STARLAB Projector**

Once the STARLAB dome has been inflated, you can unpack and begin setting up the projector. Since it is dark inside the STARLAB, use a flashlight or an extra lamp attached to an extension cord to light the inside of the dome while you're working.

Remove the projector from its case.

**Note**

*Always carry the projector by the two heavy metal bars on either side.*

Carefully remove the three protective coverings from the top of the projector. There should be a large cardboard or plastic tube, black plastic netting and a small black plastic cap that covers the projector bulb.

**Note**

*It is very important that you don't lose these items. You will need them when you pack up the projector again. It is best to place them inside the projector case in the small rectangular compartment when not in use.*

Once the protective coverings are removed, place the projector case inside the dome where it will be used as the stand for the projector. First, unhook the lid from the pro-

\* A new style of travel cases began shipping with systems in January 2005. If you have new cases, please refer to the note on the top of page 13.

jector case and store it in a safe location outside of the dome.\* Then lay the case flat on its back, lift the side of the inflated dome and slide the box under the fabric.

Unravel the power cord that is attached to the projector and plug it in.

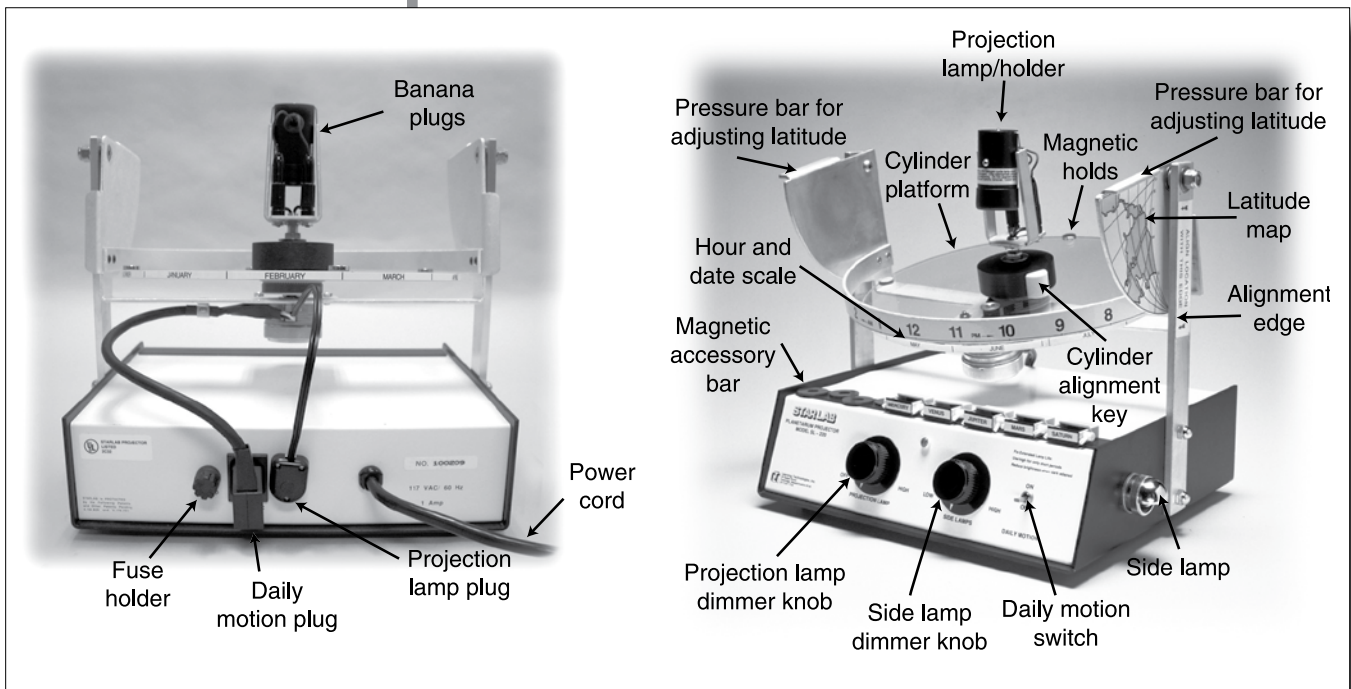
**Note**

*Do not plug in the projector until after the protective coverings have been removed. If the projector was left in the "on" position, the plastic bulb covering can melt into the projector head causing damage!*

Refer to the two diagrams of the projector and follow these simple steps.

1. Plug in the motor drive for the daily motion on the projector as indicated in the diagram. On the back of the projector is a large 3 prong plug attached to a short wire that must be plugged into the large 3 prong outlet in the back of the projector.
2. Check to make sure that the projection lamp plug is plugged in.
3. Turn on the projector by turning the left-hand knob in a clockwise direction. You should see the LED on the projector light.
4. Turn the right hand knob all the way in a clockwise direction to turn on the side lamps. These will provide ample work light for you to set up the projector inside the dome.
5. With the projector on, lift the side of the dome and carefully slide the projector into the dome making sure that the lights don't rest against the fabric. You can now enter the dome and continue setting up the projector.

Once the projector and carrying case (stand) are inside the dome, you can set the projector on its stand and prepare to conduct the program. Turn the case on its side so that the handle is pointing toward the inflation tunnel. The handle should not be on the top of the box. Move the case to the center of the dome and carefully place the projector on the box so that the side lamps shine down over the side of the box. (See top photo next page.) The main projector bulb should be directly under the center of the dome.



The projector should then be placed on top of the case oriented with the side lamps hanging over the edge. This will maximize floor brightness.

**Note**

*If you have the new-style travel cases (shipped with systems beginning in January 2005), the Projector Travel Case is too large to be used as the stand for the projector inside the dome. Instead, use either the Blower Travel Case or the Cylinder Travel Case as the projector stand (for either the FiberArc and Standard projectors). Close and lock the lid (they are not removable) and place the case in the center of the dome. The case should be placed on its side (not the hinge or latch side). This will bring the projector to the correct height (approximately 25").*

Turn on the projector and test all of the lamps. If any of the lamps fail to light, refer to the troubleshooting guide on page 33. Test the motor drive by flipping the toggle switch labeled "Daily Motion" into the "on" position. The plastic plate on the projector should begin to rotate slowly. If the plate does not move, make sure the cable from the motor is securely plugged into the large three-pronged outlet on the back of the projector. If the plate still doesn't turn, refer to the troubleshooting tips on page 33. If the plate turns correctly, turn off the switch before putting on a cylinder.

**Changing the Projection Cylinders**

All of the projection cylinders used on the STARLAB planetarium are designed to work in the same way. They are made out of film and should be handled gently because they are easily crushed. Cylinders should be handled from the top and bottom rather than the sides. Before touching the cylinder, hands should be cleaned and free of hand lotion and perspiration.

Cylinders are held on the projector by four magnets attached to the clear plastic cylinder platform. At the bottom of each cylinder is a 2.5 inch diameter hole with a small notch cut into it. The hole allows the cylinder to be placed over the top of the projector and the notch lines up with the small white tab (cylinder alignment key) on the cylinder platform of the projector. When changing cylinders, the latitude adjustment bar must be set at 90 degrees in the polar position (straight up and down) and the clear plastic plate should be horizontal.

**Warning**

*Changing cylinders when the support plate is tilted can cause severe damage to the projector!*

Note the position of the cylinder alignment key on the cylinder platform and carefully slip the cylinder over the top of the projector until it rests on the clear plastic platform. Hold the platform with one hand so it does not rotate and slowly rotate the cylinder in either direction until the notch on the cylinder lines up with the cylinder alignment key.

**Note**

*On most cylinders the notch is directly under the seam on the side of the cylinder.*

When this happens, you will hear a "click" and the cylinder will lock into place. To remove the cylinder, first make sure that the projector is set for 90 degrees latitude (straight up and down). Grasp the cylinder at the sides directly under the top ring and gently pull straight up until the cylinder pulls free of the magnets. The magnets are quite strong so don't be surprised if it requires a little force to remove the cylinder.



*Shown above: the old-style Projector Travel Case as the projector stand in the dome. For systems shipped beginning in 2005, use the Blower or Cylinder Travel Case to achieve the correct projector height in the dome (see photo below).*



*New-style Blower Travel Case as projector stand.*



### Note

When cylinders are not in use, they should always be stored in either the projector case or a cylinder case. Never leave a cylinder loose on the floor where it can get damaged!

## Adjusting the Projector Brightness

The two dimmer knobs on the STARLAB projector allow you to set light conditions that mimic a true sky for anywhere in the world. When the side lamps are turned completely off and the projector bulb is at maximum brightness, you will have true “dark sky” conditions viewing approximately 3000 stars down to 5.5 magnitude. By turning up the side lights, you can simulate twilight conditions (sunrise and sunset) and show students a more realistic “light polluted” sky which they may be more accustomed to. When you first begin the planetarium program, most participants will not have had enough time for their eyes to “dark adapt” so you need to begin with the projector bulb on maximum brightness. Dim the sidelights gradually and usually after about 5 minutes, participants’ eyes will become adapted to the dark. You may now turn the projector bulb down to about 80% brightness. This will still allow the stars to be seen clearly, and it will greatly extend the life of the projector bulb.



The projector in this photo is set for Nov. 1 at 10:00 PM.

## Adjusting the Date and Time

You can set the STARLAB projector to view the sky for any hour of darkness for any day of the year. Along the front of the projector is a fixed hour bar showing viewing times from 7:00 PM to 5:00 AM. The 12:00 is midnight. Below the hour bar on the edge of the clear plastic cylinder platform are the months of the year.

Look at the accompanying graphic. Dates are approximated and can be set by turning the platform so that the relative day of the month is aligned under the selected viewing hour. For example, if you want to view the sky at 10:00 at night on November 1<sup>st</sup>, rotate the platform so that the tick mark between October and November is slightly to the left of the 10 on the hour bar. The projector is now set for 10:00 PM standard time for November 1<sup>st</sup>. Please note that in this position the projector is also set to show you the night sky at 9:00 PM on November 18<sup>th</sup> and 8:00 PM on December 4<sup>th</sup>. Remember you can view the same stars in the same position in the sky at different times for different days of the year.

For daylight savings time, subtract one hour from the time you want to set the projector. For example, to view 10:00 PM on June 7<sup>th</sup>, rotate the plate so that the first half of June is directly under the 9 on the hour bar.

### Note

When adjusting the time, always rotate the plastic cylinder platform plate directly. Turning the cylinder may cause damage.

## Adjusting the Latitude

You can set the STARLAB projector to view the sky from any location in the northern or southern hemisphere (from the pole to the equator) by tilting the projector support plate and using the Latitude Adjustment Bar found on the right-hand side of the projector. Look at the accompanying graphic. Below the latitude bar is a distorted map with latitude lines drawn every 15 degrees. When the projector is straight up and down, you are at the pole. When it's tilted all the way over to one side, you are at the equator. Decide what latitude you wish to view the sky from and calculate where it would be on the map using the marked latitude lines as a guide. If need be, estimate the position by interpolating between the marked lines. Tilt the entire projector platform until the desired location lines up with the edge of the bar marked “align



The projector is set for 60 degrees latitude.

location with this edge." The cylinder stays tilted due to friction and will stay in this position until you change it.

**Note**

*When tilting the cylinder, always use the two metal brackets on the two sides of the projector and never push directly on the cylinder because it may damage it. When changing cylinders, always reset the projector to the polar position.*

## Maintaining the STARLAB Standard Projector

### Changing the Projector Bulbs

The STARLAB Standard Projector has two different sets of lights that will require replacement from time to time. Only use replacement lamps from Science First/STARLAB.

**Note**

*Any substitution of bulbs could cause electrical damage to the projector and will void the warranty!*

Replacement bulbs should be stored in the accessory box inside the blue netting. Before changing any bulb, confirm that it has blown by making sure that the projector is plugged in and that the main power switch is on. The red LED in the front of the projector should be lit. Once you have confirmed that the projector is getting power, turn it off again and unplug it from the electrical outlet.

### Replacing the Side Lamps

The two side lamps (Part # SL-551) used to illuminate the STARLAB dome have standard bayonet mount sockets and look like the type of bulb used in the tail light of a car. To replace these bulbs, first allow the metal cowling to cool. Completely unscrew the cowling that covers the bulb. Once the cowling has been removed, gently press in on the bulb while rotating it in a counterclockwise direction. After about 1/4 of a turn, the bulb should pop out. Place the new bulb into the socket, press in gently and rotate about 1/4 turn in a clockwise direction. You should feel the bulb lock into place. Plug the projector back in, turn on the projector and turn the right hand dimmer to see if the bulb lights. Replace the metal cowling.

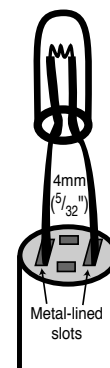
### Replacing the Projection Lamp

The STARLAB Standard Projector uses a halogen cycle projection lamp (Part # SL-550). This micro-miniature bulb is a specially made, state-of-the-art light source. Because of halogen-tungsten recycling, the lamp features an extremely small filament for extra sharp star images with virtual elimination of bulb blackening. The projection lamp is designed to operate for approximately 20 hours with the projector at the highest brightness setting. Filament life, however, is a function of many factors and can be greatly extended by decreasing the bulb brightness by 10% when operating the projector.

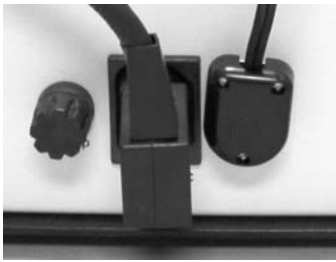
Unlike the side lamp bulb, the projection lamp has no socket attached to it, only two bare wires that slide directly into the head of the projector. The projector bulb can shatter if it becomes scratched or damaged. Extreme care should be used in handling the bulb. Skin oils and dirt on the fingers can reduce the usable life of the bulb so it is suggested that you don't handle it directly. Instead, use cotton gloves or a tissue. If you must handle the bulb with your fingers directly, make sure they are clean and dry!



The side lamp bulb.







*The projector lamp plug shown up close on right.*



*The banana plugs should be plugged in tightly.*

Before replacing the projection lamp, it is a good idea to make sure that the bulb is indeed burned out. There are several places where the power to the bulb can become disrupted, making it appear that the bulb has blown. First check to see that the projector itself is plugged in and that there is power. The side lamps and daily motion drive should be able to work even if the projector bulb is burned out. Next check the back of the projector and make sure that the smaller plug that provides power to the projector head is plugged into the back of the projector. (This plug will occasionally become tangled in the projector wire and might become loosened when the projector is first unpacked.) Next, look at the head of the projector and make sure the two "banana plugs" that carry the power from the top of the projector to the projector lamp housing are plugged in tightly. (These sometimes are loosened when the protective netting is removed from the projector head.) Refer to the accompanying graphics.

If all of the plugs are secure, first reseat the existing bulb to make sure that a connection problem is not the cause. Remove the old lamp from its socket by pulling it straight up. With your fingers, straighten the two wire leads on the old bulb and set them so that they are about 4 mm (5/32 inch) apart. Shine a flashlight straight down into the empty projector head. You will see four slots, two with metal sleeves and two without. Slowly insert the wire leads into the two metal-lined slots in the projector head. They should slide in about 1/4 inch. Stop when you feel resistance. **MAKE CERTAIN THAT YOU DO NOT BEND THE LEADS!**

When the bulb is properly seated, the top of the bulb should extend about 1 mm above the top of the projector head. Plug in the projector again and turn on the power. If the bulb still does not light, turn off the projector, remove the old bulb and discard it. Do not put it back into the yellow accessory box! Take a fresh bulb out of the accessory box. Each projector bulb is stored inside a small red plastic cap with a white foam plug in the end. Slowly pull out the foam plug. It will have the two wire leads from the new bulb embedded in it. Remove the bulb from the foam plug and straighten the leads with your fingers. Insert the new bulb into the projector head the way you did before and test the bulb by turning on the projector. If the bulb still does not light, go to troubleshooting tips on page 33.

### **Changing the Fuse on the Standard Projector**

On the STARLAB Standard Projector, the fuse is located at the rear of the projector next to the small black knurled fuseholder cap with the label "1 Amp." To access the fuse, unscrew the cap by turning it counterclockwise. The old fuse should come out with the cap.

Replace the old fuse with a new one (available from Radio Shack Part #270-1021 1 Amp, 250V. 1 1/4" x 1/4"). Then push the cap back onto the fuseholder base. Push it in slightly while turning clockwise to screw the fuse and cap back into place.

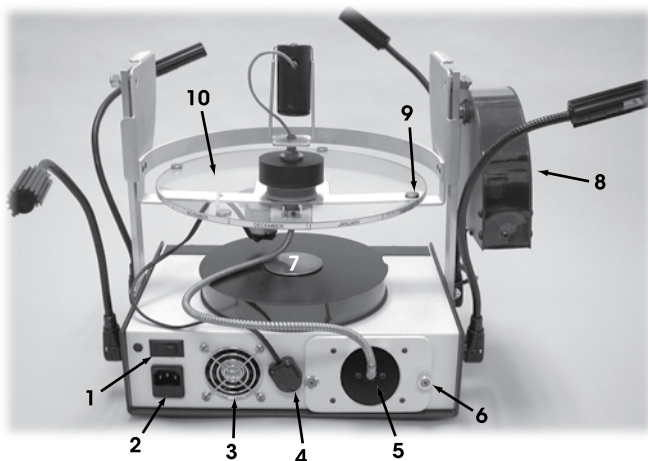
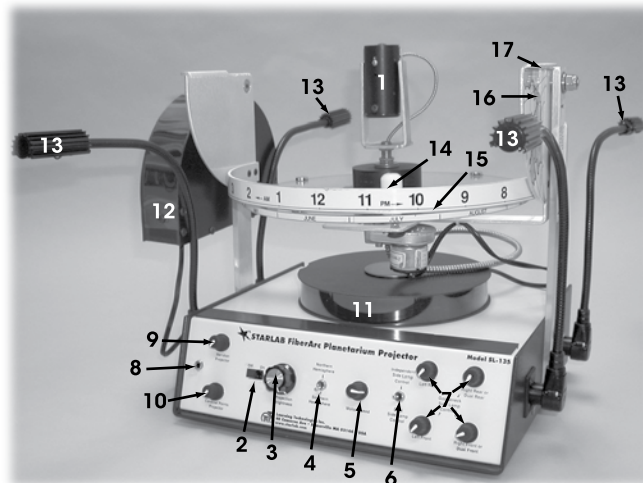
# STARLAB FiberArc Projector

## Introduction

The STARLAB FiberArc Projector uses a revolutionary means of projecting images. By replacing the standard halogen projection bulb with a combination of a high intensity arc-lamp light source and a state-of-the-art fiber optic light guide, the FiberArc provides an image clarity that is unsurpassed by any other portable planetarium projector available today.

While the STARLAB FiberArc uses the same projection cylinders and setting procedures as the STARLAB Standard Projector, it also offers a variety of new options not previously available. The FiberArc includes separate meridian and cardinal points projectors that greatly expand the way that the planetarium can be used. In addition, a variable speed motor allows you to adjust the speed of Earth's rotation and a selector switch allows you to change the direction for either the northern or southern hemisphere. The FiberArc also includes four "gooseneck" side lamps that can be controlled either individually or in tandem. By manipulating these side lamps into a variety of positions, you will be able to effectively provide reading light for yourself and participants without disrupting the night sky. They can be adjusted to simulate sunrise and sunset and various levels of light pollution. And, they can be adjusted to illuminate the control panel.

Because the STARLAB FiberArc Projector has many more controls than the STARLAB Standard Projector, it is important that users familiarize themselves with all of the different components and maintenance requirements.



## Front

- 1 FiberArc lens and fiber-optic housing: gimbaled light source for projection
- 2 Projection on/off switch
- 3 Projection brightness knob
- 4 Switch for platform rotation: clockwise for the northern hemisphere, counterclockwise for the southern hemisphere
- 5 Motor speed control: controls the speed of the daily motion platform
- 6 Switch for independent vs. dual side lamp operation
- 7 Four gooseneck side lamp knobs: control the brightness of the gooseneck side lamps
- 8 Power Indicator Light
- 9 Meridian Projector knob: controls brightness of the Meridian Projector
- 10 Cardinal Points Projector knob: controls brightness
- 11 Cardinal Points Projector: produces images of the directional points N, NE, E, SE, S, SW, W, NW
- 12 Meridian Projector: produces a scale from northern horizon to zenith to southern horizon with degrees of declination marked in 5° intervals
- 13 Four removable, fully-adjustable gooseneck side lamps: each has a 5-watt bulb in the head. Illuminates the dome, entry tube, control panels on the projector and is useful for low-light reading
- 14 Cylinder alignment key: correctly positions the cylinder on the projector
- 15 Hour and date scale
- 16 Latitude map
- 17 Pressure bar for adjusting latitude

## Back

- 1 On/Off switch
- 2 Power outlet: also access to fuse
- 3 Cooling fan
- 4 Motor plug and outlet
- 5 Access to projector lamp
- 6 Locking screw
- 7 Access to Cardinal Points Projector bulb
- 8 Access to Meridian Projector bulb
- 9 Magnetic cylinder fastener: secures the cylinder in place on the projector
- 10 Transparent cylinder platform

In writing this manual we have tried to be as thorough as possible but inevitably, questions will arise. If you have any questions concerning the use, operation or maintenance of the STARLAB FiberArc Projector, please call our toll free number at 1-800-537-8703 and we will be happy to assist you.

## Unpacking and Setting Up the STARLAB FiberArc Projector

The STARLAB FiberArc Projector is packed in a STARLAB projector case with one or two projection cylinders. In systems shipped prior to January 2005, the projector case doubles as the stand for the projector when it is set up in the planetarium. In systems shipped after January 1, 2005, use the Blower Travel Case or Cylinder Travel case as the projector stand in the dome to achieve the appropriate height for the projector. See pages 12-13 for more details on this.

When the projector is first shipped from the factory, it is encased in plastic wrap and the power cord is not attached. After it has been initially set up, the plastic wrap can be discarded and the power cord can stay attached to the projector. Remove the Velcro strap around the head of the projector.

### Note

*When repacking for transit, wrap the power cord around the base of the projector under the clear plastic cylinder support plate. Fold the four gooseneck side lamps under the plastic plate and fasten the small Velcro strap around the head of the projector (leaving the fiber optic cable free) to keep it stable during transit.*

Before setting up the projector in the planetarium dome, remove it from the case and check to make sure all of the components are operating properly.

Carefully lift the projector out of the box using the two heavy-duty aluminum bars located on either side of the projector. When carrying the projector, always hold it by these bars with two hands.

### Note

*Never attempt to lift or carry the projector by the gooseneck side lamps!*

Place the projector on a table or similar stable work surface and carefully unwrap the power cord from around the base of the projector. Plug the projector into a working outlet and make sure that the other end of the power cord is securely plugged into the back of the projector. The power cord supplied with the STARLAB FiberArc is 8 feet long and should be plugged into a grounded extension cord or outlet.

### Note

*The power cord for the FiberArc is not hard wired into the unit, but attaches to the projector by means of a three-prong plug. Unless this plug is in tight, the projector will not operate.*

Carefully unfold the four gooseneck side lamps from under the transparent cylinder platform and direct them off to the sides of the projector. Once you have set up the projector inside the planetarium dome, you can adjust these lamps to give you appropriate room lighting.

Turn on the projector by pressing the on/off toggle switch located on the back of the projector (#1 on lower diagram on previous page). When you turn on the switch, the red indicator light on the front of the projector and the cooling fan should turn on. If the projector does not turn on, make sure that the power cord is securely plugged into the back of the projector and that the outlet you have the cord plugged into is live. A good way of testing the outlet is to plug in the STARLAB fan and turn it on. If the outlet is working and the cord is secure, then you should check the fuse on the projector to make sure that it is intact. (See section on changing the fuse on page 24 for detailed instructions.)

## Changing the Projection Cylinders

All of the projection cylinders used on the STARLAB planetarium are designed to work in the same way. They are made out of film and should be handled gently because they are easily crushed. Cylinders should be handled from the top and bottom rather than the sides. Before touching the cylinder, hands should be cleaned and free of hand lotion and perspiration.

Cylinders are held on the projector by four magnets attached to the clear plastic cylinder platform. At the bottom of each cylinder is a 2.5 inch diameter hole with a small notch cut into it. The hole allows the cylinder to be placed over the top of the projector and the notch lines up with the small white tab (cylinder alignment key) on the cylinder platform of the projector. When changing cylinders, the latitude adjustment bar must be set at 90 degrees in the polar position (straight up and down) and the clear plastic plate should be horizontal.

### Warning

*Changing cylinders when the support plate is tilted can cause severe damage to the projector!*

Note the position of the cylinder alignment key on the cylinder platform and carefully slip the cylinder over the top of the projector until it rests on the clear plastic platform. Hold the platform with one hand so it does not rotate and slowly rotate the cylinder in either direction until the notch on the cylinder lines up with the cylinder alignment key.

### Note

*On most cylinders the notch is directly under the seam on the side of the cylinder.*

When this happens, you will hear a “click” and the cylinder will lock into place. To remove the cylinder, first make sure that the projector is set for 90 degrees latitude (straight up and down). Grasp the cylinder at the sides directly under the top ring and gently pull straight up until the cylinder pulls free of the magnets. The magnets are quite strong so don't be surprised if it requires a little force to remove the cylinder.

### Note

*When cylinders are not in use, they should always be stored in either the projector case or one of the cylinder cases. Never leave a cylinder loose on the floor where it can get damaged!*

## Controlling the Projector Brightness

### Note

*The STARLAB FiberArc Projector is unique because it uses a high-intensity arc lamp to illuminate the projection cylinder and display the images on the dome. Because of its design, the arc lamp requires about one minute to reach its full brightness. If THE PROJECTION LAMP IS TURNED OFF FOR ANY REASON, YOU MUST WAIT AT LEAST 3 MINUTES FOR IT TO “RE-CYCLE” BEFORE TURNING IT ON AGAIN.*

Before turning on the projection lamp, you must make certain that the projector head is free to swing back and forth. When the projector is packed for shipping, a Velcro strap is wrapped around the projector head to keep it stable. Remove this strap by gently pulling it free and place it in a safe place (such as the accessory box) because you will need it for packing up the projector again.

After you have turned on the projector and removed the Velcro strap, slide the on/off switch immediately to the left of the knob labeled “Projection Brightness” to the “On”



position. You should see the light come on in the top center of the projection head. After about one minute the lamp will be fully warmed up and you will be able to control the brightness by turning the knob labeled "Projection Brightness" in a clockwise direction.

### Side Lamp Control

The four gooseneck side lamps are controlled by means of four dimmer knobs located at the extreme righthand side of the projector control panel (see photo on right). A toggle switch allows you to select how these dimmer knobs will operate the lamps. When the toggle switch is up, ("Independent Side Lamp Control"), the four dimmer knobs will work independently of each other. This means that turning the dimmer labeled "Left Rear" will only control the left rear side lamp. To brighten the lamp, turn the dimmer in a clockwise direction and to dim, turn it in a counterclockwise direction. When the toggle switch is down, ("Dual Side Lamp Control"), the right side dimmers will control both of the front or rear side lamps together. In other words, when the toggle switch is down, the right rear dimmer (upper right knob) will control both rear side lamps and the right front dimmer (lower right knob) will control both of the front side lamps. The left dimmers will not be useable. By having the side lamp switch down, the operator can light all four side lamps by using only two dimmers.

In addition to being able to control the brightness of the side lamps, you can adjust the direction the light shines by bending the goosenecks. When moving the lamps, it is important to go slowly and make sure that you don't twist them, only bend them in one direction at a time. You can also adjust the direction of the side lamps by turning the plastic cowlings that cover the bulbs at the top of the gooseneck. While it is not recommended, it is important to note that the goosenecks that hold the side lamp bulbs can be removed from the projector body. Each gooseneck is attached with a three-pronged connector and the entire lamp assembly can come loose or even become disconnected if the gooseneck is twisted excessively.



The projector in this photo is set for Nov. 1 at 10:00 PM.

### Adjusting the Date and Time

You can set the STARLAB projector to view the sky for any hour of darkness for any day of the year. Along the front of the projector is a fixed hour bar showing viewing times from 7:00 PM to 5:00 AM. The 12:00 is midnight. Below the hour bar on the edge of the clear plastic cylinder platform are the months of the year.

Look at the accompanying graphic. Dates are approximated and can be set by turning the platform so that the relative day of the month is aligned under the selected viewing hour. For example, if you want to view the sky at 10:00 at night on November 1st, rotate the platform so that the tick mark between October and November is slightly to the left of the 10 on the hour bar. The projector is now set for 10:00 PM standard time for November 1st. Please note that in this position the projector is also set to show you the night sky at 9:00 PM on November 18th and 8:00 PM on December 4th. Remember you can view the same stars in the same position in the sky at different times for different days of the year.

For daylight savings time, subtract one hour from the time you set the projector. For example, to view 10:00 PM on June 7th, rotate the plate so that the first half of June is directly under the 9 on the hour bar.

#### Note

*When adjusting the time, always rotate the plastic cylinder platform plate directly. Turning the cylinder may cause damage.*



## Adjusting the Latitude

You can set the STARLAB projector to view the sky from any location in the northern or southern hemisphere (from the pole to the equator) by tilting the projector support plate and using the Latitude Adjustment Bar found on the right-hand side of the projector. Look at the accompanying graphic. Below the latitude bar is a distorted map with latitude lines drawn every 15 degrees. When the projector is straight up and down, you are at the pole. When it's tilted all the way over to one side, you are at the equator. Decide what latitude you wish to view the sky from and calculate where it would be on the map using the marked latitude lines as a guide. If need be, estimate the position by interpolating between the marked lines. Tilt the entire projector platform until the desired location lines up with the edge of the bar marked "align location with this edge." The cylinder stays tilted due to friction and will stay in this position until you change it.

### Note

*When tilting the cylinder, always use the two metal brackets on the two sides of the projector and never push directly on the cylinder because it may damage it. When changing cylinders, always reset the projector to the polar position.*

## Earth Rotation Control

The STARLAB FiberArc has a variable speed motor and a selector switch to control the direction of Earth's rotation to match that of either the northern or southern hemisphere. The platform rotation switch is a toggle near the center of the projector control panel. Flipping the switch up to the "Northern Hemisphere" position causes the cylinder to rotate in a clockwise direction. Flipping the switch down to the "Southern Hemisphere" position causes the cylinder to rotate in a counterclockwise direction.

The speed of the rotation is controlled by the knob labeled "Motor Speed" located directly to the right of the direction control switch. Turning the dial clockwise increases the speed and counterclockwise decreases the speed. When the knob is completely counterclockwise (off), you can also move the projection cylinder manually by rotating the bottom of the clear plastic cylinder support plate.

### Note

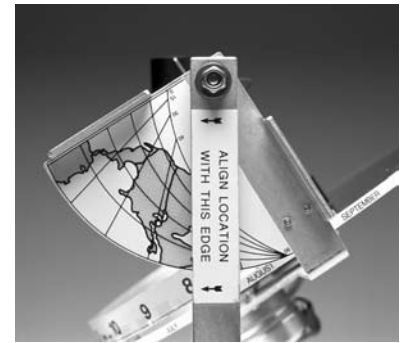
*Rotating the projector at maximum speed may cause some individuals to experience motion sickness.*

## Using the Cardinal Points and Meridian Projectors

The STARLAB FiberArc Projector has two accessory projectors built into it to allow you to add specific reference points to the projections on the dome. The two knobs on the left-hand side of the front of the projector, independently control each projector.

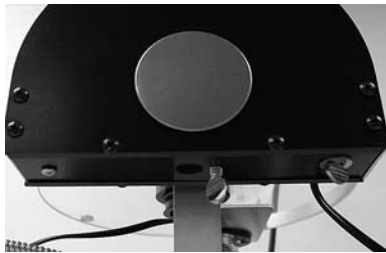
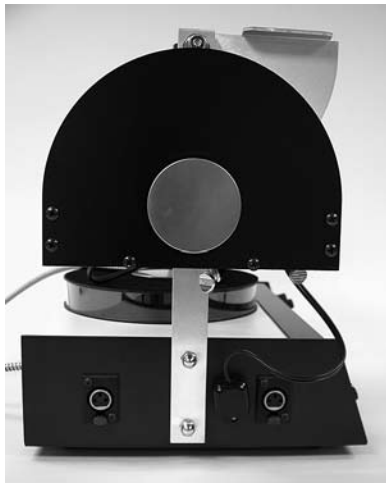
The Cardinal Points Projector is built into the base of the FiberArc Projector directly below the clear plastic projection cylinder platform. When it is on, it projects letters showing the 8 cardinal directions (N, S, E, W, NE, NW, SE and SW) along the horizon. The brightness of these letters is controlled by the dimmer knob labeled "Cardinal Points Projector". Turning the knob in a clockwise direction increases the brightness while a counterclockwise direction dims it down to off.

The Meridian Projector is attached to the support bracket found along the lefthand side of the FiberArc Projector. When it is on, it projects a scale (at 5 degree increments) across the top of the planetarium dome showing the angular measurement from the northern horizon to the zenith and across to the southern horizon. It is very



The projector is set for 60 degrees latitude.





Gooseneck neck side lamp with cowling removed.

useful for measuring star angles in celestial navigation and for calculating the position of the sun along the ecliptic during different months of the year.

### Setting the Position on the Meridian Projector

The position of the Meridian Projector will be set at the factory, however, it may shift when changing the bulbs (see page 23) or when in transit. To check alignment, put the Starfield Cylinder (SL-321) on the projector in the STARLAB dome. Turn on the projection lamp, the Cardinal Points lamp and the Meridian lamp. If properly aligned, the 90 degree mark at the top of the dome should be directly over the pole star. The meridian coordinates at the horizon (0) should be vertically aligned 5 inches above the cardinal points of N and S.

The thumbscrew towards the front of the projector controls the alignment along the lines of longitude. When loosened, this screw slides left and right. Slowly slide the thumbscrew as needed until the meridian scale is aligned directly over the pole star. Once adjusted, turn the thumbscrew counterclockwise to tighten it.

The thumbscrew nearest the center of the projector (see bottom photo at right) controls the vertical position of the declination marks (it moves the marks up and down). Loosen or tighten this thumbscrew as needed to align the declination marks so that the 0 is 5 inches above the cardinal points of N and S. When the scale is balanced, you are finished setting the Meridian Projector.

#### Note

*The above procedure works with either the Standard or Giant Dome.*

### Maintaining the STARLAB FiberArc Projector

#### Note

*Before changing any bulb on the STARLAB FiberArc Projector, make certain you disconnect the projector from the power supply and allow the bulb at least 5 minutes to cool off.*

### Changing the Gooseneck Side Lamp Bulbs

Before changing a side lamp bulb, make certain that the gooseneck assembly is securely attached to the main body of the projector. The side lamps are attached to the projector by means of a three-pronged connector, which can become disengaged if the projector is handled roughly. If the gooseneck seems loose, press the small tab below the connector and pull gently on the assembly so that it disengages completely. Then insert the end of the gooseneck assembly back into the connector until it "clicks" firmly into place. If the side lamp still doesn't light, change the bulb.

The first step is to remove the plastic cowling that covers the bulb at the end of the gooseneck. The cowling simply slides on and off. Once the cowling has been removed, gently press in on the bulb so that it moves deeper into the socket and give it a slight turn in a counterclockwise direction. The bulb has a bayonet mount, which means that it has two little tabs holding it in the socket. As you twist it, the bulb should pop right out of the socket. Take a replacement bulb from the accessory box and insert it into the socket. Press down slightly and twist in a clockwise direction to lock the bulb in place. After you have changed the bulb, plug the projector back in and test it. If the new bulb lights, discard the old bulb and order a replacement as soon as possible.



## Changing the Bulb on the Meridian Projector

### Note

*The same bulbs (SL-550) are used in both the Meridian and Cardinal Points projectors. These are halogen cycle bulbs that have no socket assembly, only two small wire leads. Because they are halogen bulbs, it is important that they be handled as little as possible. Skin oil and moisture can reduce their life expectancy. You should always clean and dry your fingers before handling the bulbs.*

The bulb for the Meridian Projector is located behind a black plastic cap on the left-hand side of the Meridian Projector. To access the bulb, use a thin bladed, flathead screwdriver to carefully pry off the cap (see photo at left). Make sure you hold the Meridian projector firmly in one hand while removing the cap. Once the cap has been removed, reach into the opening and carefully lift the bulb from its socket. Replace the bulb with one from the accessory box found in one of the small red plastic caps attached to white foam.

When inserting the halogen bulbs in their sockets you must place the wire leads directly in the center of the sockets that have the metal inserts. Using a small flashlight will help you see the socket better. Push the bulb in gently until you feel resistance. Do not push so hard that you bend the wire leads on the bulbs! Once you have replaced a bulb, test it before putting the cap back into place. You may have to remove the bulb and reset it in the socket if it does not light the first time.

When you have successfully replaced the bulb, replace the cap by grasping the Meridian projector firmly in one hand so it doesn't move. Snap the cap back in place.

## Changing the Bulb on the Cardinal Points Projector

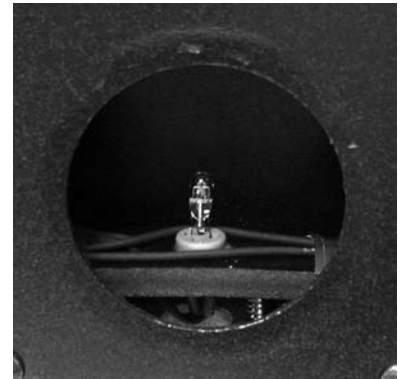
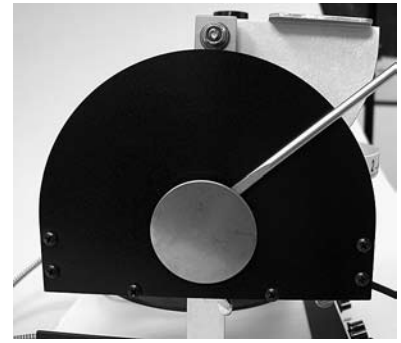
### Note

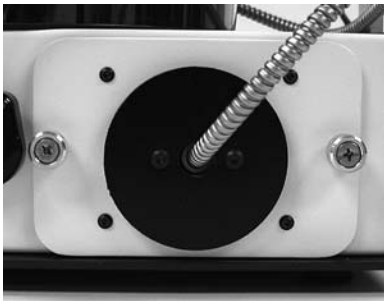
*The same bulbs (SL-550) are used in both the Meridian and Cardinal Points projectors. These are halogen cycle bulbs that have no socket assembly, only two small wire leads. Because they are halogen bulbs, it is important that they be handled as little as possible. Skin oil and moisture can reduce their life expectancy. You should always clean and dry your fingers before handling the bulbs.*

The bulb for the Cardinal Points Projector is located under the black plastic cap directly on top of the Cardinal points Projector, beneath the clear plastic projection cylinder support plate. The easiest way to access this bulb is to first tilt the cylinder support plate so that the Latitude Adjustment Bar is set for the Equator. (The cylinder support plate should be in the vertical plane.) Using a thin blade flathead screwdriver, carefully pry off the cap (see top photo at right). Once the cap has been removed, reach into the opening and carefully lift the bulb from its socket. Replace the bulb with one from the accessory box found in one of the small red plastic caps attached to white foam.

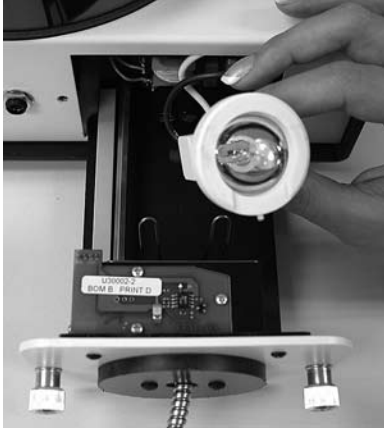
When inserting the halogen bulbs in their sockets you must place the wire leads directly in the center of the sockets that have the metal inserts. Using a small flashlight will help you see the socket better. Push the bulb in gently until you feel resistance. Do not push so hard that you bend the wire leads on the bulbs! Once you have replaced a bulb, test it before putting the cap back into place. You may have to remove the bulb and reset it in the socket if it does not light the first time.

Once the bulb in the Cardinal Points Projector has been successfully replaced, carefully snap the cap back into place and tilt the clear plastic cylinder support plate back into the horizontal position.





Shown above is the pull out drawer with two locking screws.



## Changing the Arc Lamp Projector Bulb

The main projector bulb is located in the rear of the projector in a pull out drawer that is secured with locking screws. The light from this bulb is transferred to the projector head via a fiber optic cable that runs from the back of the projector to the projector head and looks like a corrugated metal cable. The replacement projector bulb looks similar to the type of bulb found in an overhead or slide projector.

Before attempting to change the projector bulb, disconnect the projector from the power supply and remove the small black motor plug from the back of the projector. (This plug provides power to the motor that rotates the cylinder plate.) It is also helpful to have a second person assist you in changing the bulb. Loosen both locking screws on the sides of the metal plate on the back of the projector.

Once these knobs have been loosened, carefully slide the drawer out of the back of the projector. The bulb is located behind the circuit board and is held in place by two U-shaped metal locking tabs and a metal locking bar. To release the bulb from its housing, gently pull the two metal tabs toward you from the top and slide the metal locking bar up and over the tabs. Once the locking bar has been removed, gently push back on the two U-shaped metal locking tabs and the bulb will begin to slide back out of its cylindrical housing. When the front of the bulb is clear of the housing, lift it up and out of the projector by the ceramic base. Two wires will be attached to the back of the bulb via a black plastic connector. Pull the connector from the back of the bulb and plug in the replacement bulb. Please note that the plug polarized so that the connector on the back of the bulb will only attach in one direction. You might have to rotate the bulb 180 degrees to get it to plug back in correctly.

When you have plugged in the replacement bulb, push back on the two metal tabs again and slip the new bulb into the back of the housing.

### Note

*Go slowly! Do not force the bulb in place or you may crack its ceramic housing!*

Once the new bulb is properly seated inside the cylindrical housing, pull the two metal tabs forward again and flip the metal locking bar over them securing the bulb. Slowly slide the drawer back into the projector making sure you don't catch any loose wires in the drawer. When the drawer is all the way back in position, you should hear a slight click. Tighten the two screws on the drawer. Replace the plug for the motor drive and plug the projector back into the power supply. Turn the projector on to test the bulb.

If the bulb does not light, it may be because the drawer has not been pushed back in all the way. There is an inter-lock in the drawer that disconnects the power and if it is not properly set, the power will not go to the bulb. (This is the click that you hear when you push the drawer back.) To test this, loosen the locking screw and push the drawer back in again. Then re-tighten the screw. If the bulb still doesn't light, the bulb may have been damaged when you put it in the housing. Call Science First/STARLAB at 1-800-537-8703 for assistance.

## Changing the Fuse on the FiberArc Projector

On the STARLAB FiberArc Projector, the fuse is located inside the assembly where the power cord attaches to the back of the projector. To access the fuse, you must unplug the power cord from both the wall outlet and the back of the projector. Don't misplace the cord because you will need it to operate the projector later! With the cord removed, look inside the power outlet and you should see a small horizontal slot

at the base of the housing near the outside edge. There is a small picture of a fuse on the outlet just below the slot on the outside (see photo at right).

Insert the blade of a flat head screwdriver into this slot and gently pry open the cover. The fuse cover should slide out of the back of the housing. Inside the cover there should be two fuses. The exposed fuse is the "active" fuse while inside the cover there should be a spare fuse. Remove the active fuse by pulling on the black plastic tab. Examine the fuse to see if it shows signs of being blown. (A blown fuse may look black and the fuse element inside will be melted.) Replace the blown fuse with the spare in the fuse holder or with a spare fuse from the accessory box. With the new fuse in the "active" slot, slide the fuse holder back into the outlet so that it clicks tight. Make sure that you replace the fuse holder in the same direction as you took it out. (The printing on the holder should be right side up.) Test the projector by replacing the power cord and plugging it in. If the projector still doesn't work, or if you continue to blow fuses, please contact Science First/STARLAB for further assistance at 1-800-537-8703.

### **Important Note**

*If you do replace a fuse, you should immediately purchase a new fuse so that you always have a spare. The STARLAB FiberArc Projector is equipped with a 5 Amp, 12 Volt fuse. All replacement fuses should be of this power rating. While you can purchase these fuses at most hardware or electronic stores, we suggest that you purchase all STARLAB replacement parts directly from Science First/STARLAB.*



# Projecting the Sun and Moon

## Note

*These instructions apply to both the Standard and FiberArc Projectors.*



## The Sun

The Starfield Cylinder is unique because, unlike most of the cylinders, it has twelve magnetic light blocks around its circumference. These light blocks mark the position of the Sun along the ecliptic and when one is removed, it shows where the Sun would appear in the sky for each month of the year. Each light block is located directly above the name of a particular month listed on the cylinder platform on the projector. The position of the Sun has been set for approximately mid-month with the exception of March, June, September and December. On these months it has been offset to show the Sun on the 22<sup>nd</sup> of the month. This allows you to show the position of the Sun in the daytime sky for the equinox and solstice dates. To remove a light block, simply pull it out and place it on the magnetic strip located along the top front of the projector. This will keep the light block from getting lost. Set the projector for the desired latitude and turn the cylinder so that the "Sun" is seen on the eastern horizon. This is sunrise. By turning on the daily motion switch, you will see the Sun slowly move across the sky until it finally sets. This allows you to observe the elevation of the Sun, location of sunrise and sunset and the relative amount of time it takes to cross the sky for each month of the year making it easy to demonstrate the reason for the seasons.

## The Moon

While most people realize that the moon goes through a phase cycle, many don't understand that there is a clear-cut relationship between the phase of the moon and what time of day it's visible in the night sky. The reason we see the moon is because it's reflecting sunlight back to us on Earth. While half the moon is always being lit by the Sun, we don't always see the lit side. The chart at the top of the following page shows the relationship between the moon phases and the time of the day that they can be seen.

Because the moon is normally found to travel close to the ecliptic, and since it has the same apparent diameter as the Sun in the sky, the same light ports used to project the Sun can be used to project the moon in the sky. In order to show the phases of the moon, two identical sets of 5 magnetic moon phase inserts have been included in the STARLAB accessory box.

One set of inserts can be used to show the waxing phases while the second set can be used to show the waning phases. Each set includes a slim crescent, a wide crescent, a quarter, a narrow gibbous and a wide gibbous. A full moon is projected by removing the light block and leaving the light port completely open. For a new moon, leave the light port blocked. Use the following procedure for setting a specific moon phase.

## Background

There are 29.5 days in one lunation, or complete set of moon phases. If the moon is full on the 15th of a particular month, then it will be full about the 14th or 15th of the following month. Because our months have lengths from 28 days (February) to 31 days, the phase repetition does not occur on the same day each month. In calendars

Age in Days	Phase Name		#	Position
1 to 3	First Waxing Crescent		1	1 <sup>st</sup> hole to the right of the Sun
4 to 6	Second Waxing Crescent		2	2 <sup>nd</sup> hole to the right of the Sun
7	First Quarter (waxing)		3	3 <sup>rd</sup> hole to the right of the Sun
8 to 10	First Waxing Gibbous		4	4 <sup>th</sup> hole to the right of the Sun
11 to 13	Second Waxing Gibbous		5	5 <sup>th</sup> hole to the right of the Sun
14 to 15	Full Moon	No Insert Used		6 <sup>th</sup> hole to the right/left of the Sun
16 to 19	First Waning Gibbous		6	5 <sup>th</sup> hole to the left of the Sun
20 to 22	Second Waning Gibbous		7	4 <sup>th</sup> hole to the left of the Sun
23	Last Quarter (waning)		8	3 <sup>rd</sup> hole to the left of the Sun
24 to 26	First Waning Crescent		9	2 <sup>nd</sup> hole to the left of the Sun
27 to 29	Second Waning Crescent		10	1 <sup>st</sup> hole to the left of the Sun
	New Moon	No Insert Used		No hole is unblocked

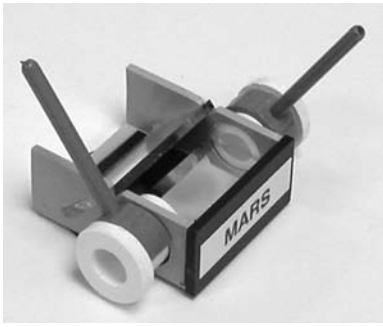
that are true lunar calendars, like the Jewish, Chinese, or Muslim calendars, the phases repeat exactly each month, so the 1<sup>st</sup> of each month will be a new moon.

### Procedure

- Determine how old the moon is. The age of the moon can be determined by looking at a calendar showing moon phases, by checking the newspaper for this information, consulting a source like the Abrams Sky Calendar, or referring to an internet site such as [www.skypub.com](http://www.skypub.com) for information about the current sky. Determine when the previous new moon was.
 

Examples:

  - If the new moon occurred on the 4<sup>th</sup> of May, and today is the 9<sup>th</sup> of May, then the moon must be 5 days old.
  - If the new moon occurred on the 20<sup>th</sup> of November, and today is the 5<sup>th</sup> of December, then the moon is 15 days old (10 days left in November, and 5 days for December).
- Consult the chart and select the correct moon insert. Follow the directions on the chart in placing the insert in the correct hole on the cylinder.
  - If you are showing the moon for May, and determine that the moon is 5 days old for the date you have chosen, select insert #2 (First Waxing Crescent) and after removing the light block from the hole positioned 2 holes to the right of the May Sun's position, place insert #2 in that hole. Be sure to turn the insert so that the visible portion of the moon is facing toward the Sun hole for May.
  - If you are showing the moon for December, and determine that the moon is full (about 15 days old) for the date you have chosen, simply remove the block from the hole positioned 6 holes to the right or left of the Sun. It is directly opposite the Sun's position hole, on the other side of the cylinder.



## Projecting Planets with the Starfield Cylinder

In addition to the magnetic moon phase inserts, the STARLAB accessory box also contains 5 clearly marked planet projectors that allow you to place any or all of the naked eye planets into the night sky. The planet projectors have the same type of magnetic attachment system as the moon phases and they use the same light ports on the STARLAB cylinder. Each planet projector is designed with a moveable mirror that allows the image to be accurately placed in the sky. In addition, each planet projector has its own filter and aperture so that the projections have a realistic color and magnitude. Using the planet projectors, you are able to project up to 5 planets in the night sky at the same time.

Start by identifying which planets you wish to project by looking at a detailed star map for the month you wish to view the sky. Star maps showing planetary positions can be found at many different Web sites as well as publications such as *Astronomy*, *Sky and Telescope* and *Science and Children*. You can also subscribe to monthly star maps and the sky calendar from the Abrams Planetarium in East Lansing Michigan. The star map will give you the exact location of the visible planets relative to the constellations and the ecliptic.

Set the Starfield cylinder for the correct date and time and then locate the position in the sky where the planet should be. Find the light block closest to that position and remove it. If this light port is being used to project either the Sun or the moon, remove the light block from the next light port over to either the right or left. Place the magnetic bottom of the planet projector over the hole so that it "locks" into place.

Make sure that the planet projector is centered over the hole in the cylinder. If the light does not shine directly through the hole, the brightness of the planet will be diminished or it will not be visible at all. Gently move the handle on the planet projector back and forth while looking toward the sky. You should see a bright "star" moving back and forth. This is the planet you are projecting. By rotating the planet projector in the hole and by moving the handle that controls the mirror, you can move the planet into the desired location. If you are setting more than one planet, you can move onto the next one and the first planet will remain set in its position, even when the Starfield cylinder is put into motion.

### Note

*Be careful not to force the handle of the planet projector beyond the stopping point or you can damage the mirror. When the planet projectors are attached to the Starfield cylinder, the cylinder will not fit in the round cylinder storage bin in the projector case. If you want to remove the cylinder and use it again without resetting the planet projectors, you can store the cylinder temporarily in the large rectangular bin in the projector case. Never clean the mirror on the planet projector with any abrasive cleaner or material. They are easily scratched!*



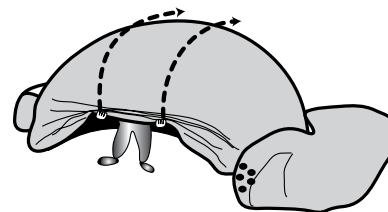
## **Taking Down and Packing Up The STARLAB**

After you have completed your STARLAB presentations for the day, it's time to break down and repack the STARLAB back into its cases.

### **Note**

*If you are going to use the STARLAB for several days and it's in a secure room, it is not necessary to completely pack it up each night. Simply place the projector on the floor next to the stand, leave the side lights on and exit the dome. Pull out the power cords and turn off the fan. The STARLAB will deflate and the fabric will rest on the stand making a "tent" over the projector. When you turn the fan on again, the STARLAB dome will inflate and then you can plug in the projector and place it back on the stand, picking up where you left off the day before.*

Start by removing all planet projectors and moon phases from the Starfield cylinder and putting them back into their proper places in the accessory box. Make sure that you replace the steel light blocks in all the light ports, take the Starfield cylinder off the projector and slide it back in one of the round storage compartments in the projector case. Turn off the projector and place it on the floor next to the projector stand. Exit the dome and turn off the fan. The STARLAB dome will begin to deflate. After it has dropped about 3 feet, go to the side of the dome opposite the two tunnels and lift the material about 5 feet off the ground flipping it back toward the opposite side of the dome. If you do this quickly, the dome will ride back on the air that was trapped inside forming a crescent shaped pile of fabric on the floor as shown in drawing at right. Allow the dome to sit for a few minutes so that the remaining air gets out of it and continue packing up the projector and fan.



Unplug the fan from the power outlet and unsnap the inflation tube. Wrap the power cord of the fan around the two metal brackets on the back of the fan and place the fan inside its box, snapping the lid shut. Place the fan case off to the side so that it is out of the way.

Unplug the projector from its power outlet and unplug the power to the motor that controls the daily motion from the back of the projector. Make sure that the latitude adjustment for the projector is set at 90 degrees (polar position, straight up and down) and carefully wrap the power cord for the projector around the base of the projector directly underneath the clear plastic cylinder platform. Put the protective packing material back on the top of the projector. Lay the projector case/stand so that it is flat on its back on the floor and place the projector inside the large rectangular compartment.

### **Note**

*Always carry the projector by the two heavy metal bars on either side. Place the accessory box in the smaller rectangular compartment of the projector case along with any flashlights, extra pointers or other accessories that you are using with your STARLAB. Make certain that the pointers are turned off before storing them in the accessory box!*

Place the lid on the projector case by inserting the two hinges in their tabs.



### Note

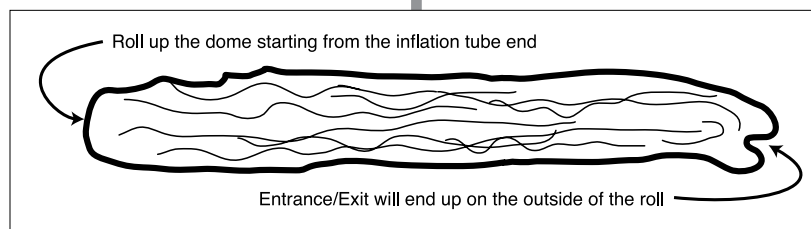
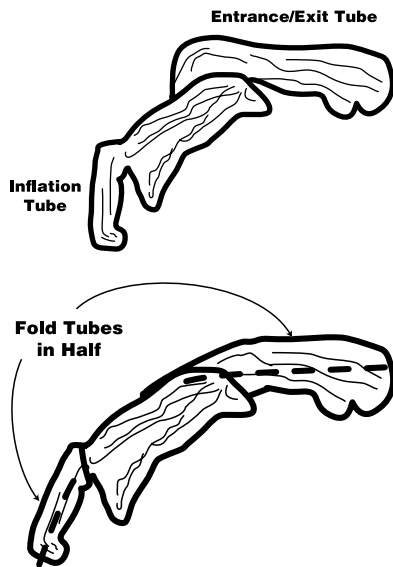
Make certain that you are using the correct lid! The lid for the cylinder cases is the same size as the projector case lid. The cylinder case lids DO NOT have cut outs for the projector and if they are forced on the projector case, they can cause serious damage to the projector!

Once the lid has been placed on the case, snap it closed and move it off to the side next to the fan case.

### Rolling and Packing the STARLAB Dome

While the STARLAB dome can be rolled in many different ways, the following procedure is the recommended method.

1. Once the dome has been flipped over and deflated, it should look like a large crescent shape on the floor with the two tunnels sticking out.
2. Fold the inflation tube over so it lays flat on the rest of the dome material. Fold the entrance tunnel in half lengthwise over on itself, and then fold it a second time so that it is now lying flat on the dome fabric. 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 (one meter). Do not make it too narrow or wide because it will not fit back in to 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 trapped air come out. Kneeling or sitting on the dome will help to push the air out.
4. Once the dome has been completely rolled up, secure it with the two luggage straps. 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 will get moldy.



## ***Routine Maintenance of the STARLAB***

While the STARLAB planetarium system is designed to stand up to repeated use, it does occasionally need some routine maintenance to keep it operating in top form. Here are basic maintenance procedures that should be done periodically.

### **Dome**

The dome is made from a nylon/vinyl (no latex) composite fabric and is bonded together with specially-formulated adhesive. While the fabric is quite durable and does not tear easily, it can get small punctures that allow light to shine through from outside creating extra “stars” in the sky. These holes can be patched using peel-off adhesive backed dome patches found in the accessory box. To patch the dome, inflate it in a brightly lit room and enter with a flashlight. Turn off all the lights inside the dome and wait for any “stars” to shine through. Since the projector is not on, these “stars” are holes. Peel and stick the patches onto the dome from the inside so they completely cover the hole. If holes are too high to reach, simply turn off the fan and allow the dome to deflate until you can reach the holes. Do not use duct tape to patch holes.

If the dome gets dirty, it can be wiped clean with a sponge while inflated with warm soapy water. Never use cleaning fluids or solvents!

### **Note**

*Never stand on a ladder or chair to patch holes. In the dark it's easy to become disoriented and fall.*

### **Projector**

Before cleaning the projector, make certain that it is unplugged from the electrical outlet. Both the projector case and the clear plastic cylinder support platform can be cleaned with glass cleaner and a soft cloth or paper towel. After repeated use, the latitude adjustment bar may begin to sag. It can be easily tightened by using a  $\frac{5}{32}$  inch hex wrench and a  $\frac{1}{2}$  inch wrench over the nut that holds it to the metal support bars attached to the side of the projector. Be careful not to over-tighten the nuts because you won't be able to adjust the latitude!

### **Projection Cylinders**

Projection cylinders are made from film and, while they are made to last, they need to be handled with care. Any dents to the cylinder should be removed as soon as possible. Dents can usually be popped out by applying light pressure on the outside of the cylinder around the dent. Never put anything inside the cylinder because it can scratch the images. Normal fingerprints on the outside of the cylinder will eventually degrade the projections. It is not recommended that you try to clean the cylinders. They should be packed up and sent back to Science First/STARLAB for periodic cleaning. In an emergency, cylinders can be cleaned with distilled water and a soft LINT FREE cloth. NEVER use any type of soap, solvent or window cleaner on the cylinder! When the outside of the cylinder is damp, it is extremely tacky and lint, dust and dirt can easily stick to it, permanently damaging the cylinder. NEVER get water or any other liquid inside the cylinder as it will destroy the images!



## **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. The nuts on the support bracket of the fan should be tightened periodically with a wrench to keep them from rattling.

## **Troubleshooting**

### **What happens if the projector does not go on even when I know the power outlet works?**

*There is a fuse on the back of the projector that may break if the projector is dropped or handled improperly. If the projector fails to turn on, replace the fuse with one from the accessory box.*

### **What happens if I turn on the daily motion switch and the cylinder doesn't rotate?**

*First check to see if the large rectangular plug is securely attached to the back of the projector. If so, check and see if the belt that drives the cylinder at the base of the projector is tight. It may have become stretched or it may have broken. In either case, a replacement belt can be ordered from Science First/STARLAB. After many years of use, it is possible that the motor may burn out. A replacement motor can be ordered from Science First/STARLAB. (Part # SL-153).*

### **What happens if I'm missing some light blocks for the Starfield cylinder?**

*Spare light blocks are included in the accessory box and new light blocks can be ordered from Science First/STARLAB. DO NOT USE adhesive backed dome patches or tape to cover the light ports on the Starfield Cylinder!*

### **What happens if I change the projection bulb on the Standard Projector and it still does not light?**

*While it is possible that the replacement bulb is burned out, it's not usually the case. First try using another replacement bulb. If it still does not work, make certain that the 1/4 inch phone plug at the back of the projector and the two "banana plugs" near the top of the projector head are both securely plugged in. On rare occasions, the wires leading to the "banana plugs" can get pulled out. If they do, you must remove the plug, unscrew it and replace the wire.*

### **What happens if I see "stars" shining through the dome even when the projector is turned off?**

*The extra stars are really tiny holes in the dome. They can be easily patched by using the pre-adhesive peel-and-stick dome patches included in the accessory box. Extra dome patches can be ordered from Science First/STARLAB. See the section on dome maintenance (page 31) to learn the proper procedure for patching the dome.*

## **STARLAB User Tips**



### **Entering and Exiting the STARLAB**

Because the STARLAB dome is an air-supported structure, leaving the door open for an extended period of time will cause the dome to begin to deflate. As a result, it's necessary to have visitors enter the dome in a controlled fashion. Visitors 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 STARLAB 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. Have the last person entering the dome turn the fan down to medium or low.

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 rock excessively. Nobody 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 the STARLAB does not have any seats, one suggestion is to lay 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. When people are exiting the dome, the fan should be on "high."



### **Accommodating Visitors Who are Physically Challenged**

Because of its unique design, the STARLAB can accommodate visitors who are restricted to wheelchairs, have walkers or are otherwise physically challenged. Instead of having these individuals use the entrance tunnel, they can enter and exit the planetarium by going in and out under the edge of the dome. To do this, you will need a second person to assist you. Individuals who are physically challenged should be brought into the dome before the rest of the visitors. Begin by turning up the fan to the highest setting so that the STARLAB dome becomes overinflated and starts lifting off the floor. Remove all carpet squares from the inside of the dome and maneuver the individual to the side of the planetarium directly opposite the point where the entrance and inflation tubes attach to the dome. With the help of a second person, lift the side of the STARLAB 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 re-inflate. Once the dome has fully re-inflated, have the rest of the participants enter the dome through the entrance tunnel making sure to keep the entrance tunnel clear. Have the last person entering the STARLAB turn the fan back down to low. Once the entire group has been seated, back the wheelchair into the opening to the entrance tunnel. This way, they will be able to

see everything without blocking the view of other visitors. When the program is over, move the wheel chair out of the tunnel and position it next to the projector. Allow the rest of the group to leave via the entrance tunnel and then remove the person in the wheelchair the same way that you brought them in.

### Seating Inside the STARLAB Dome

Placing carpet squares on the floor to establish a seating pattern helps to make things more orderly for classes entering the STARLAB. Not only do these pads help to define each student's space, but also they make sitting on a cold, hard floor a bit more comfortable. Carpet squares can usually be obtained from large carpet stores who 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.

### Accessory Lighting Inside the STARLAB Dome

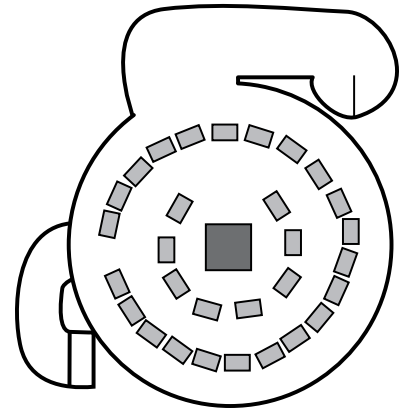
There are many occasions where you might want additional lighting in the planetarium. In order to perform activities like reading star maps and completing worksheets, it is very helpful to use an auxiliary light source. One system that works well for the STARLAB planetarium involves using one or more 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 downwards to provide light for reading and writing. This allows images to still be seen on the dome while the lights are on. A second 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 in the entrance tunnel 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 40-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.

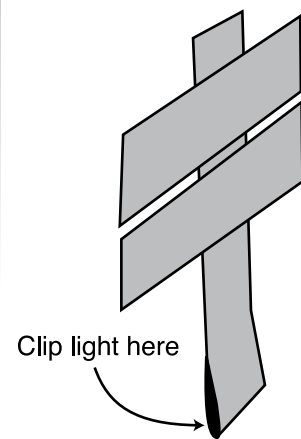
A six-volt camping lamp or lantern is a perfect addition to help provide extra lighting in the tunnel when people enter and exit the dome. By placing it on the floor at the inner end of the tunnel, people can be directed to "walk toward the light" without tripping over the material or wires. Adding an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

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 5-watt bulbs in lightweight, clip on sockets with small metal reflectors. Extension cords plugged into a tabletop or hand-held dimmer, can be 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.



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



## **Marking Positions On the Dome**

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 the STARLAB, it is possible to mark all of these things using Post-it style notes or index cards backed with double stick 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 dayglow or phosphorescent paint.

## **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. Science First/STARLAB also manufactures a heavy duty LED pointer that comes in several different designs. (Part #SL-541, A-J) These LED pointers are better for student use than laser pointers because they are far more durable, have a longer battery life, and most importantly, they pose no risk to eyes even if they are shined directly into a person's face.

## **Dome Management**

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 directly under the center of the dome. Each time a group exits the STARLAB, it's a good idea to go back outside and realign the dome to its original position. The amount of dome shift can be reduced by making sure that there are no kinks, deep wrinkles, or bends in the inflation tube. Placing carpet squares along the inside edge of the dome will help to weigh the dome down which also reduces drift.

### **Note**

*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!*

## **Creature Comforts**

A whole day of teaching in the STARLAB 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 gardeners' knee pads help a lot. A short stool (camping stool) or kindergarten chair can also be used if you prefer to sit up and, 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!