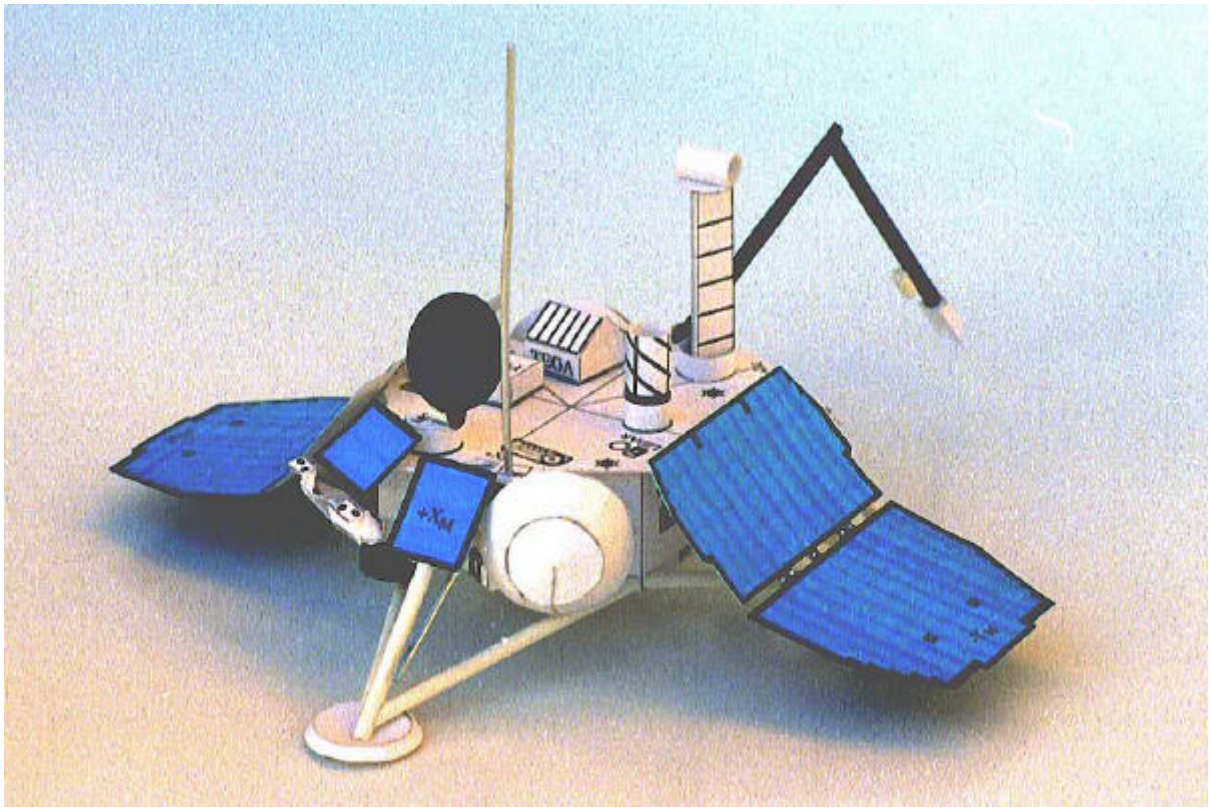
Mars Polar Lander
1/24 Scale Model Assembly Instructions

This scale model of the Mars Polar Lander spacecraft is designed for anyone interested, although it might be inappropriate for children younger than about ten years of age. Children should have adult supervision to assemble the model.



1 SETUP

1.1 DOWNLOAD AND PRINT

- Download the Parts file from the web page to your computer. It contains paper model parts on several pages of annotated graphics.

- Print the Parts file with a black & white printer; a laser printer gives best results. It is highly recommended to print onto card stock (such as 110 lb cover paper). If you can't print onto card stock, regular paper will do, but assembly will be more difficult and the model will be more fragile. The card stock or paper should be white. The Parts file is designed for either 8.5x11-inch or A4 sheet sizes.

- Check the "PRINTING CALIBRATION" on each Parts Sheet with a ruler, to be sure the cm or inch scale is full size. If it isn't, adjust the printout size in your printing software.

1.2 YOU WILL NEED THE FOLLOWING TOOLS

- A good pair or scissors.

- An art knife, such as X-ACTO #11, with a sharp new blade. Children must have adult supervision, of course, to use an art knife. You'll also need a cutting surface such as a linoleum pad, or thick chipboard, when using the art knife. Use caution: you can hurt oneself, or the furniture, with an art knife.

- About 12 Q-Tips (for making the Lander Legs and the Robot Arm).

- Glue. Use regular white glue (Elmer’s Glue-All® or equivalent). You might also try thick white glue, sold in art and fabric stores, called “TACKY GLUE” (Aleen’s or equivalent).

- A round pencil or dowel to wrap curvature into some parts.

- A metal ruler to use as a straight edge.

- A blue highlighter to use for coloring some parts.

- A black permanent marker to use for coloring some parts.

- A push pin strong enough for making a hole in cardstock paper.

- A No. 1 size paper clip (about 1.25 inches in length) for making one of the science instruments.

- Space. Set up a well-lighted, comfortable work area, with room to set glued parts to dry.

- Time. Don't hurry. Plan to spend several hours for assembly. About 6 hours would probably be minimum if you concentrate solely on assembly. It can easily be done in short steps, however, over a period of several days.

- Patience. There may be trying times. But remember that extra care, and time, will pay off with a surprisingly accurate representation of the spacecraft.

1.3 BEFORE BEGINNING ASSEMBLY

- **Read all of the instructions**. Compare model parts with images. Examine the Parts Sheets and read the names of all the parts.

- Get your bearings: During assembly, you'll notice the spacecraft axes are indicated. These three imaginary lines pass through the center of mass of the spacecraft, and are labeled X, Y, and Z. Additionally, several coordinate frames were used during spacecraft development. These are denoted with D for descent, M for mechanical and C for cruise.

1.4 OTHER NOTES

- Sections marked with a • may be accomplished at the same time if two or more people are working on assembly, or if you wish to work on one section while glue dries on another. In fact these steps were performed separately in building the actual spacecraft.

- What to cut out? Each part is drawn against a shaded background. This shading appears gray when printed on a black & white printer. Each part should be completely cut away from its shaded background. Some parts have areas within them of shaded gray. These areas should be cut out of the part. Spacecraft details are printed on most of the parts. Don't confuse these with background shading. If there's any question, look at it on a color computer monitor: all the background shading appears blue: if it isn't blue, don't cut it away.

- When you finish cutting out a part, flatten it. If an instruction doesn't say which way to fold something, fold in either direction.

- When instructed to fold a part, consider scoring it first. To do this, line up a metal ruler or straight edge along the line to be folded, and very lightly score it with an art knife, only breaking the surface of the card stock. You have to be very careful not to cut through if you do this. While this is more time consuming, it will result in much neater folds, and will help the parts fit together properly.

- If you cannot print the model parts onto card stock (such as 110 pound cover paper), then skip over the steps which indicate to "VERY lightly score using a modeling knife." It is highly recommended to print onto card stock.

- When instructed to roll a part, wrap the part around a dowel or round pencil. This will make a more even curvature in the part. Alternatively, try "drawing" the part between your finger and the sharp edge of a table of desk to warp curvature into the part.

2 ASSEMBLY

• 2.1 ASSEMBLE THE LANDER BODY

• a. Prepare Science Deck

1) Cut out the Science Deck Top and the Science Deck Bottom from PARTS SHEET 1. Smear a thin film of glue (a glue stick works well for this) on the back (non-printed side) of both pieces and glue together. Be sure to do a fit check prior to applying the glue to make sure the pieces are aligned correctly.

2) With a push pin, poke a hole through the Science deck in the dot located inside the box labeled MET. Make the hole size such that a paper clip will fit snugly. Place the Science Deck under something flat and heavy (like a book) and allow to dry.

• b. Assemble Lander Helium Tank Assembly (LHTA)

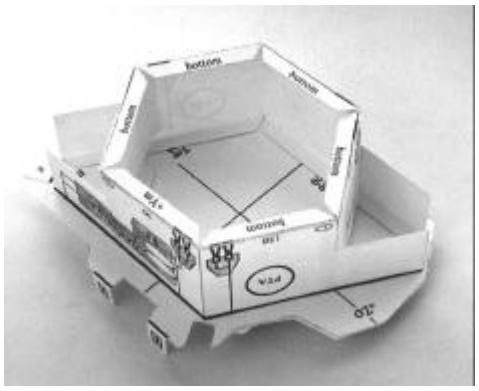
1) OPTIONAL STEP (easier method): Two different sets of helium tanks are provided. The easier assembly method uses the parts marked "Optional", and are assembled by cutting out the Lander Helium Tank Assembly (LHTA) halves marked "Optional" located on PARTS SHEET 2. Fit them together at right angles, slot into slot, and secure with glue. These intersecting pieces represent a domed cylindrical tank. Repeat for other tank. Skip the steps in the following section that build solid body tanks.

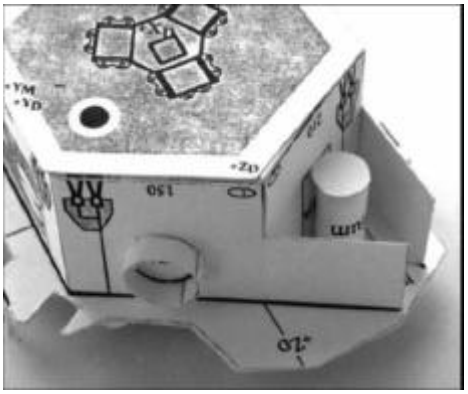
2) Assemble Solid Body Lander Helium Tank Assembly

a) Cut out the Lander Helium Tank Assembly (LHTA) parts from PARTS SHEET 2 (there are three parts per tank). Form the long part marked "Helium" into a cylinder by rolling the part to impart a curved shape. Smear a thin film of glue on the tab marked "G", overlap the opposite edge onto the glue, and adjust as necessary to make an even cylinder.

b) Apply glue along one of the edges of the cylindrical part marked "Helium" and attach one of the small circular parts. Repeat with the other small circular part on the other end to complete the tank. Repeat these steps to build the second tank.

c. Install Side Panels, Equipment Deck Bottom and Propellant Tank Assembly (PTA) Mounts





1) Cut out the 330/270 Side Panels, 150/90 Side Panels, 30 and 210 Side Panels (labels are near the bottom tab), and the Equipment Deck Bottom from PARTS SHEET 1. Do not cut out the gray-shaded middle portion of the Equipment Deck Bottom.

2) Score the tabs on the Side Panels lightly with a knife, being careful not to cut through the paper, and bend the tabs away from the printed side. Also, score along the line between the 330/270 Side Panels, and the 150/90 Side Panels.

3) Apply a thin layer of glue to the side panel tabs labeled "Top 330, Top 270, Top 150 and Top 190". Glue the tabs to the corresponding labels on the Science Deck Bottom and allow drying.

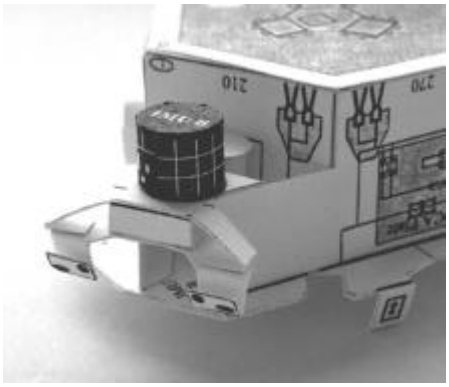
4) After the 330, 270, 150 and 90 degree panels have set, apply a thin layer of glue to the three tabs labeled "30, 30, and Top 30" on the 30 degree panel. Glue the tab labeled "Top" to the corresponding label on the Science Deck Bottom and inside the 90 and 330 degree panels and allow drying. Repeat with the 210 degree panel.

5) Apply a thin layer of glue to the tabs labeled "bottom" and position the Equipment Deck Bottom into place. Be sure to align the +Y_M axis on the Equipment Deck to the corresponding label on the bottom of the 90 degree panel.

6) Cut out the two PTA mounts from PARTS SHEET 1 and roll into a ring. Glue the tab marked "glue" and overlap the opposite end so the tab is covered. Glue the PTA mounts onto the PTA labels located on the 330 and 150 side panels and allow drying.

7) Glue the helium tanks to the rectangles labeled "LHTA" on the 30 and 210 Side Panels.

2.2 ASSEMBLE THE IMU's and REM's



a. Assemble and Install the Inertial Measurement Units (IMU) Mounts

1) Cut out the IMU Mounts from PARTS SHEET 1. Using a modeling knife, very lightly score along the straight line forming two tabs on each IMU Mount. Bend each tab 90 degrees away from the printed side.

2) Smear a thin film of glue to the tabs on the IMU Mounts and apply to the inside of the corresponding side panels. The tabs should be applied to the inside of the Side Panels, and the circle labeled "IMU" should be facing away from the Science Deck. Make sure to double check the placement of the A and B mounts with the corresponding label on the bottom of the Science Deck.

b. Assemble and Install the Inertial Measurement Units (IMUs)

1) Cut out the six Inertial Measurement Unit (IMU) parts from PARTS SHEET 1.

2) Form the long part into a cylinder with the dark printing on the outside of the part. Smear a thin layer of glue on the tab marked "glue", overlap the opposite edge onto the glue, and adjust as necessary to make an even cylinder.

3) Apply glue along the top edge of the cylinder and attach the part marked "IMU" with the printed ring on the outside. The round piece should be the same diameter as the cylinder, and evenly touch the top edge of the cylinder.

4) Apply glue along the bottom edge of the cylinder and attach the part marked "bottom" with the printed ring on the outside. The round piece should be the same diameter as the cylinder, and evenly touch the bottom edge of the cylinder.

5) Repeat steps 1 through 4 of the remaining IMU parts to complete a set of two Inertial Measurement Units.

6) Smear a thin film of glue to the bottom of "IMU A" and attach the part to the corresponding location on the "IMU A" Mount. Repeat with "IMU B".

c. Assemble and Install Rocket Engine Motor (REM) Brackets

1) Cut out the two parts labeled "REM Brackets" from PARTS SHEET 1 and lightly score the lines on the parts lightly with a knife to help in folding.

2) Fold each part to form a square tube so the label "g-IMU" is on the outside and the label "glue" in on the inside. Glue the tab labeled "glue" to the inside of the newly formed square tube, fold the tabs labeled "g" and glue to the underside of the part labeled "REM" and allow to dry.

3) Fold the white triangle on the outside of the parts up 90 degrees towards the printed side. Fold the rectangle adjacent to the white triangle toward the printed side until the edge of the white triangle touches the "REM" label. Glue the white triangle to the "REM" label. Fold the rounded rectangle with the two dots on them (these dots are the REMs that poke through the backshell of the cruise stage) downward (away from the REM label) until the REMS are visible from the side.

4) Apply a thin layer of glue the IMU Bracket on the label "g-IMU", being sure to glue the IMU A bracket to the top (unprinted) side of the IMU A mount (between the IMU and the Science Deck Bottom). This will orient the Mars Descent Imager Camera (MARDI) on the correct side of the Spacecraft (underneath the MGA next to IMU A). Position the REMS facing away from the Lander Structure with the top of the REMs pointed towards the Science Deck.

• 2.3 ASSEMBLE THE LANDER LEGS



a. Assemble and Install Lander Leg Mounts

1) Cut out the three Lander Leg Mounts from PARTS SHEET 1. Score all the lines on each Lander Leg Mount lightly with a knife and bend the two long edges away from the printed side. Bend the small tabs toward the printed side.

2) Apply a thin layer of glue along the top edge and to the tabs of the $+Y_C$ Leg Mount and attach to the intersection of the 150 panel and the 90 panel aligned with the notch on the Science Deck. See picture.

3) Apply a thin layer of glue to the tabs of the +X Leg Mount and attach to the 330 panel aligned with the notch on the Science Deck.

4) Apply a thin layer of glue to the tabs of the unlabeled Leg Mount and attach to the 270 panel aligned with the notch on the Science Deck.

b. Assemble and Install the Lander Legs

1) Cut out the six Leg Foot Pad parts from PARTS SHEET 1.

2) Form the three circles into shallow cones by rolling the part to impart a curved shape. Smear a thin film of glue on the tab marked "g", overlap the opposite edge onto the glue, and adjust as necessary to make an even cone. Glue the tabs on the strips and allow drying. The inside diameter of the narrow strip should match the outer diameter of the shallow cone. Apply a bead of glue to the outer diameter of the cone and apply the inside diameter of the strip so the strip forms a rim whose slope is facing opposite the slope of the cone.

3) Cut three Q-tips to the length specified in the Lander Legs box on PARTS SHEET 1. Make a pencil mark on each Lander Leg to indicate a glue line as shown on the pattern.

4) Turn the Lander structure over with the Equipment Deck Bottom facing up. Apply glue to each of the Lander Legs from the short end to the glue line. Attach the three Lander Legs to the inside of each Leg Mount, adjusting each leg as necessary to make the legs even with the Lander structure.

5) Cut six Q-tips to the length and shape specified in the Leg Side Struts box on PARTS SHEET 1. Glue one end of a Leg Side Strut onto the oval marked with an "L" on the side panels of the Lander Structure and glue to other end to the corresponding Lander Leg. Repeat with the remaining five Leg Side Struts.

6) Apply glue to the inside cups of the three footpads and apply the footpads to the end of the Lander Legs. Place the Lander on its footpads and allow drying.

• 2.4 ASSEMBLE THE PROPELLENT TANK ASSEMBLY (PTA)

a. Assemble and Install the Propellant Tank Assembly (PTA) OPTIONAL STEP (Easier Method)

1) OPTIONAL STEP (easier method): Two different sets of propulsion tanks are provided. The easier assembly method uses the parts marked "Optional", and are assembled by cutting out the Propellant Tank Assembly (PTA) halves marked "Optional" from PARTS SHEET 2. Fit them together at right angles, slot into slot, and secure with glue. Repeat with the other set of Propellant Tank Assembly (FTA) halves. These intersecting pieces represent two domed cylindrical tanks.

2) Apply a small drop of glue the PTA Mounts on the 330 and 150 side panels of the Lander Structure. Attach the Propellant Tanks to the Lander Structure. Adjust as necessary to make the tanks even with the Lander Structure.

3) Skip the steps in the following section that build solid body tanks.

b. Assemble and Install the Propellant Tank Assembly (PTA)

1) Cut out one set of Propellant Tank Assembly (PTA) parts from PARTS SHEET 2 (there are four parts per tank).

2) Form one of the small parts into a shallow cone by rolling the part to impart a curved shape. Smear a thin film of glue on the tab marked "g", overlap the opposite edge onto the glue, and adjust as necessary to make an even cone. Repeat with the other small part.

3) Form the larger circular part into cone by rolling the part to impart a curved shape. Smear a thin film of glue on the tab marked "glue", overlap the opposite edge onto the glue, and adjust as necessary to make an even conic section. Apply glue to the edges of the smaller opening on the conic section. Attach the edges of the small cone to the smaller opening on the conic section. Adjust as necessary to make an even dome. Hint: align overlap edges of each part to be co-located on the same side of the part. Repeat with the other larger circular part.

4) Apply glue along the edge of one of the domed parts and attach the two domed parts together.

5) Apply a small drop of glue the PTA Mounts on the 330 and 150 side panels of the Lander Structure. Attach the Propellant Tanks to the Lander Structure. Adjust as necessary to make the tanks even with the Lander Structure.

• 2.5 ASSEMBLE SCIENCE INSTRUMENTS

a. Payload Electronics Box (PEB)

1) Cut out the pattern from PARTS SHEET 2 labeled "PEB". Very lightly score the lines between the tabs and sides using a modeling knife along the edge of a ruler (do not cut through the paper). Bend tabs to the inside, away from printed side.

2) Fold the part with the printed side on the outside to form a box. Apply a small amount of glue to each of the tabs and refold the part to form a box.

3) Smear a thin film of glue on the bottom of the PEB and attach to the Science Deck.

b. Thermal Evolved Gas Analyzer (TEGA)

1) Cut out the pattern from PARTS SHEET 2 labeled "TEGA". Very lightly score between the tabs and sides using a modeling knife along the edge of a ruler (do not cut through the paper). Bend tabs to the inside (away from printed side).

2) Fold the part with the printed side on the outside to form a doghouse shaped box. Apply a small amount of glue to each of the tabs and refold the part to form a box.

3) Smear a thin film of glue on the bottom of the TEGA and attach to the Science Deck.

c. Surface Stereo Imager (SSI)

1) Cut out the four parts from PARTS SHEET 2 labeled “SSI”.

2) Very lightly score along the three longest black lines that cross the larger rectangle. Form a triangular tube with the printed lines facing outward. Smear glue along the tab marked “glue” to the inside of the tube, and refold into a triangular tube. This will form the SSI Mast.

3) Roll the thin strip into a ring. Apply glue the tab marked “glue”, and overlap the opposite end to form a ring. Make sure this part fits around the triangular tube. Glue the ring around one end of the SSI Mast.

4) Glue the SSI Mast to the Science Deck, aligning to the pattern marked SSI with triangle inside the ring.

5) Glue the small circle to top of the SSI Mast.

6) Roll the rectangle with two square dots into a small cylinder. Smear glue along the tab marked “glue”, and overlap the opposite end over the glue tab (cover half of the circle with a “g” in it). Apply a drop of glue to the remaining half of the circle with a “g” showing. Center and attach to the small circle that was glued to the top of the SSI Mast. The two square dots represent the two lenses of the stereo camera.

d. Robot Arm (RA) and Robot Arm Camera (RAC)

1) Cut and notch two Q-tips to match the Robot Arm pattern found on PARTS SHEET 2, and color both parts with a black permanent marker. Glue and overlap the two notched ends of the Robot Arms to form an angle (between 45 and 90 degrees is recommended) between the outer and inner segments of the arm.

2) Cut out the Robot Arm Bracket from PARTS SHEET 2. Lightly score the two parallel lines and bend each side 90 degrees away from the printed side. Apply a small drop of glue to the small circle on the Robot Arm Bracket, and attach the part to the Science Deck. Align the Robot Arm Bracket along the $+Z_D$ axis.

3) Apply glue to the inside of the Robot Arm Bracket and attach the Robot Arm. Glue the two sides of the Robot Arm Bracket and adjust the arm away from the Science Deck (about 45 degrees is recommended).

4) Cut out the Robot Arm Scoop from PARTS SHEET 2 and lightly score along the four black lines. Fold the sides away from the printed side to form a scoop. Glue the edges of the scoop together and allow glue to dry. Apply a small drop of glue to the dot on the scoop and attach the scoop to the end of the Robot Arm. Position the inside of the scoop facing down.

5) Cut a Q-tip to the length specified on the Robot Arm Camera (RAC) template on PARTS SHEET 2. Glue the RAC to the inside edge of the robot arm (between the bracket and the scoop) about 1/8” from the scoop.

e. Meteorology Package (MET)

1) Bend a No. 1 paper clip into the shape shown on PARTS SHEET 2 in the box marked MET.

2) Push the long end of the paper clip though the bottom of the hole labeled MET in the Science Deck so the paper clip loop is resting against the bottom of the deck and the short end of the paper clip is facing away from the 330 Side Panel.

3) Apply a drop of glue between the loop of the paper clip and the science deck bottom. Apply another drop of glue between the lower portion of the MET mast and the propellant tank.

• 2.6 ASSEMBLE TELECOMMUNICATIONS ANTENNAS

a. Ultra High Frequency (UHF) Antenna

1) Cut out the UHF Antenna from PARTS SHEET 2. Roll the part to make an even cylinder with the printing on the outside.

2) Smear a thin film of glue on the tabs marked "glue", overlap the opposite edge onto the glue, and adjust as necessary to make an even cylinder.

3) Apply glue to the bottom edge of the cylinder (edge closest to the thick line), and attach the part to the Science Deck Top over the circle marked "UHF".

b. Medium Gain Antenna (MGA)

1) Cut out the four MGA pieces from PARTS SHEET 2. Carefully cut out the MGA Feed Horn; it is a delicate piece.

2) Roll the thin strip into a ring. Apply glue the tab marked "glue", and overlap the opposite end to form a ring. Apply a thin layer of glue to one edge of the ring and attach to the unprinted side of the circle labeled MGA, forming the inner gimbal.

3) Glue the open side of the inner gimbal to the Science Deck on the pattern labeled MGA. Match the position of the labels on the inner gimbal to the MGA pattern label on the science deck.

4) Cut a short piece of Q-tip to match the pattern on PARTS SHEET 2 to form the outer gimbal. Apply glue to one side of the outer gimbal and fit to the rectangular pattern on the top of the inner gimbal.

5) Score the middle line on the Feed Horn lightly with a knife. DO NOT SCORE THE LINES NEAR THE CIRCLE LABELED "g". Fold the pattern in half with the printed side facing out. Apply a thin layer of glue to the inside of the two halves and glue together. Color the edges of the Feed Horn with a black permanent marker.

6) Form the antenna dish into a shallow cone by rolling the part to impart a curved shape. Cut out the slot in the antenna dish on the line labeled with a "c" to hold the feed horn.

7) Use low-moisture glue such as a glue stick to smear a thin layer of glue on the tab marked "glue". Overlap the opposite edge onto the glue, bringing the circle into a cone, with the black printing on the inside and allow drying. Color the outside of the antenna dish with a black permanent marker.

8) Fit the Feed Horn into the slot in the MGA dish and glue in place with the square end positioned above the inside center of the dish and the dish aligned with the line near the circle labeled "g".

9) Apply glue to the circle marked with a "g" on MGA Dish/Feed Horn assembly and attach to the end of outer gimbal that is closest to the $+X_M$ axis. Position the antenna so the dish is tilted back about 45 degrees and the feed horn is along the $+X_M$ axis.

2.7 ASSEMBLE SOLAR PANELS

a. Using a BLUE highlighter, color the uncolored portion of the Main Solar Panels and Auxiliary Solar Panels (on the printed side of the panel). Best results will be obtained by using the highlighter along the edge of a ruler. Do not color the hinges or space between each panel.

b. Prepare and Install Main Solar Panels

1) Cut out the Main Solar Panels from PARTS SHEET 2. Be careful not to cut the hinges or space between each panel. There is an INNER and an OUTER Main Solar Panel for the "East" and "West" sides of the spacecraft; the OUTER panels are marked with $+Y_M$ and $-Y_M$.

2) OPTIONAL STEP: Using black spray paint, paint the unprinted side of the Main Solar Panels located on PARTS SHEET 2. Paint only the outer panel on each set.

3) Fold the Solar Panels inward (toward the printed side) along the hinge line in such a way the inner and outer panels form about a 135 degree angle.

4) Fold the four tabs located on Lander Body located on the Science Deck above the 90 and 270 degree side panels upward so the dots on the tabs (brackets) are facing upward, away from the body.

5) Apply glue to each pair of dots (brackets) on the pair of tabs (brackets) near the $+Y_M$ label on the Science Deck, and align the back side of the $+Y_M$ INNER panel over each pair of dots (see picture on Page 1). The INNER Solar Panel should form about a 45-degree angle away from the spacecraft while the outer panels (located away from the spacecraft) are almost parallel with the surface. The INNER panel will rest on the $+Y_C$ leg bracket.

6) Repeat with the $+Y_M$ INNER panel over each pair of dots on the opposite side of the spacecraft.

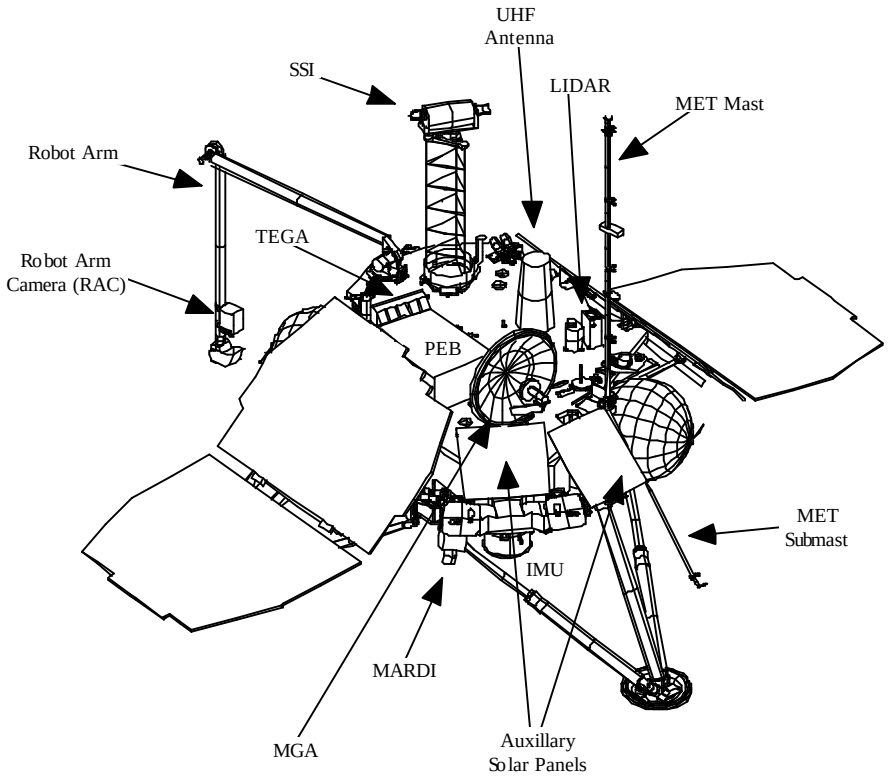
c. Prepare and Install Auxiliary Solar Panels

1) Cut out the two Auxiliary Solar Panels from PARTS SHEET 2. Glue the $+X_M$ panel onto the +X Leg Bracket.

2) Fold the small tab between the MGA and the REM bracket upward so the "g" label is facing upward, away from the body.

3) Apply a drop of glue to the tab with a "g" label and attach the other Auxiliary Panel. Align the panel with opposite orientation than the $+X_M$ Auxiliary Panel (see picture on Page 1).

THIS COMPLETES YOUR MODEL



3 ABOUT YOUR MODEL

The Mars Polar Lander is 3-axis stabilized during cruise mission phases following separation from the launch vehicle. The primary attitude determination is via star camera and an inertial measurement unit, and is backed up by analog sun sensors. The RCS thrusters provide attitude control during Trajectory Correction Maneuvers, Mars Entry Descent and Landing, and safe mode. The eight cruise thrusters are part of the Lander spacecraft, and scarfed through the Backshell. The cruise thrusters are used for Trajectory Correction Maneuvers and pitch/yaw/roll control. The Spacecraft Computer (C&DH) uses the RAD6000 processor (a predecessor to the PowerPC). The X-band link with Earth employs Cassini Deep Space Transponders, 15 W RF solid state power amplifiers (SSPA's), one transmit-only medium gain antenna (MGA) on the cruise stage, one receive-only low gain antenna on the cruise stage, and one transmit/receive medium gain antenna (MGA) on the Lander Structure. A 10-Watt RF UHF system supports the 2-way link with the Orbiter. The cruise stage solar arrays and landed solar arrays use GaAs/Ge solar cells. The electrical power electronics are based on the SSTI spacecraft electronics with NiH2 CPV batteries. The thermal control subsystem includes both thermostatically controlled and computer controlled heater circuits. Most subsystem components are redundant, with critical items cross-strapped.

The Lander entered the Martian atmosphere directly from the hyperbolic transfer orbit at 7 kilometers/second on 3 December 1999. The Lander spacecraft was designed to decelerate to a soft landing using a heat shield to aerobrake, a parachute, and actively guided propulsion to reduce vertical velocity to less than 2.4 meters/second and horizontal velocity to less than 1 meter/second at surface touchdown. Unfortunately, the lander telemetry signal was never acquired after entry into the Martian atmosphere, and the spacecraft was declared lost. The Lander was targeted to the northernmost boundary of the polar layered deposits at a high southern latitude site, about 76 degrees south latitude. The 90-day surface science mission was planned to start during late spring in the southern hemisphere and extend through the early summer season. The timing of the landing is optimal for a high southern latitude site because the sun is always above the horizon during the course of the primary mission providing maximum solar insulation and a relatively benign thermal environment.

Mars Polar Lander Spacecraft Science

The "Volatiles and Climate History" theme for the 1998 Mars Surveyor missions was recommended by the Mars Science Working Group and is aligned with NASA's Mars exploration strategy focusing on: Evidence of past or present life, Climate, and Resources. The Lander carried the Mars Volatiles and Climate Surveyor (MVACS) instrument suite, which was designed to perform in situ investigations to address the science theme "Volatiles and Climate History", the Mars Descent Imager (MARDI), and a LIDAR instrument supplied by the Russian Space Agency. The Lander was designed to search for near-surface ice and possible surface records of cyclic climate change, and characterize physical processes key to the seasonal cycles of water, carbon dioxide and dust on Mars. Piggybacking on the Mars 98 Lander were two small microprobes. Separating from the Lander just prior to entry into the Martian atmosphere, the two microprobes were designed to impact the surface of Mars at a velocity of 200 meters per second. The aeroshell on each probe was designed shatter on impact and allow the science package to penetrate up to 2 meters into the soil. The microprobes were designed to determine if water ice is present in the Martian subsurface, and will also measure the temperature and monitor the local Martian weather. The science complement for the 1998 Lander includes: the Mars Volatile and Climate Surveyor (MVACS) integrated Lander payload with Dr. David Paige of UCLA as Principal Investigator; the Mars Descent Imager (MARDI) with Dr. Michael Malin of Malin Space Science Systems as Principal Investigator; and an atmospheric LIDAR experiment provided by the Russian Space Agency Institute for Space Science. Dr. Paige's integrated Lander payload included a Surface Stereo Imager (SSI) with Mars Pathfinder heritage; a meteorology package (MET); an instrumented robotic arm (RA) for sample acquisition, soil manipulation, and close up imaging of the surface and subsurface; and the Thermal and Evolved Gas Analysis (TEGA) experiment for determining the nature and abundance of volatile material in the Martian soil. The descent images obtained by MARDI while the Lander spacecraft descends to the surface was designed to establish the geological and physical context of the landing site. The atmospheric LIDAR experiment was designed to determine the dust content of the Martian atmosphere above the landing site.

The Mars Surveyor Spacecraft was designed and manufactured at Lockheed Martin Astronautics, Denver, Colorado, under contract with the Jet Propulsion Laboratory.

Model design completed February 2000 by G. Bollendonk and K. Buhler, Mars Surveyor Program, Lockheed Martin Astronautics, Denver, Colorado. An after-hours project.