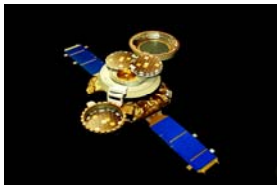
# Assembling Your Genesis Spacecraft Model

**Introduction:**



In partnership with the California Institute of Technology and NASA's Jet Propulsion Laboratory, Lockheed Martin Space System designed and built the Genesis spacecraft and sample return capsule. Lockheed Martin Space Systems Company also supported launch operations and mission operations. Lockheed Martin's John Tietz has designed a Genesis Spacecraft model that you can build at home. The following are tips for assembling your own Genesis Spacecraft model.

**Please read all the directions before you cut anything.** You'll need glue to complete the model. "Yoo-Hoo Stick" and similar adhesives don't seem to work very well. Elmer's white school glue seems to do well, but use it sparingly. If it is applied too thickly, parts will warp and the glue gets smeared on the outside of pieces. Apply a little to a toothpick and then use the toothpick to apply it to the model. Practice your technique with scraps before applying glue to the model parts.

Be sure you have an un-cut copy of the parts sheet before cutting any of the parts out so that you can identify the parts easily. You'll also need the copy to get the battery orientation right. It's best not to cut parts out before they're needed.

Cut out the parts with an Xacto-type knife. Very tiny, very sharp scissors (like the scissors that come in a small Swiss Army knife) will do for most of it, but big scissors will certainly make a mess of things.

**Materials:**

- White school glue
- Tiny, sharp scissors
- Xacto-type knife
- Toothpick(s)
- Thin cardboard

**When duplicating, photocopy the Spacecraft Assembly Parts onto card stock or thick photo paper. Enlarge to:**

- 200 % (for kids under 12 with adult supervision)
- 125 % (for the average builder)
- 100 % (for the experienced adult)

**Spacecraft Assembly Parts**

1. Front of spacecraft body
2. Back of spacecraft body
3. Lower end cap
4. Upper end cap
5. Lower cone (Sample Return Capsule, SRC)
6. Upper cone (SRC)
7. Bracket
8. Cameras
9. Launch Vehicle Adapter Ring
10. Sample-return Capsule Adapter Ring
11. Center Band Ring (SRC)

12-14 Boxes
15. Battery
16-20 Tank One Parts
21-25 Tank Two Parts

**Procedure:**

1. First, cut out the front (piece # 1) and back (piece #2) of the body. The back should be cut out neatly, following the "coastline" of the pattern closely, but the front can be cut out with half an inch or more of border. (You don't need any specific amount of border. It's just that cutting neatly is a waste of time at this point. The detailed cutting along its "coastline" will come later.) Be sure to include the three small "tabs" on the solar panels and the three tabs at the cutouts where the tanks go. The former represent equipment; the latter will be mounting brackets for the tanks.

2. Cut out and save the center circles from both front and back, where the sample-return capsule adapter ring (piece #10) and launch vehicle adapter ring (piece #9) go. At this point the pieces should look like Figure 1.

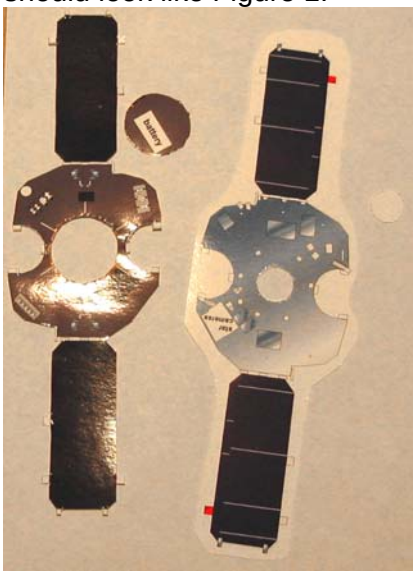


***Figure 1 Back (Left) and Front (Right) Decks***

3. Blacken the back (unprinted) side of the launch vehicle adapter ring with a felt-tip marker before cutting it out. Make loops of the two adapter rings without gluing them, and insert the rings into their respective holes. Piece #10 goes into the hole in the front; piece #9 goes into the hole in the back. Spread the glue tabs on the unprinted side of the body pieces and glue them in place. (See Figure 2) Then glue the glue tabs that joins the two ends of the ring loop. (If you glue the latter tab first, the ring may not fit neatly into the hole, and you'll end up with a warped ring.)

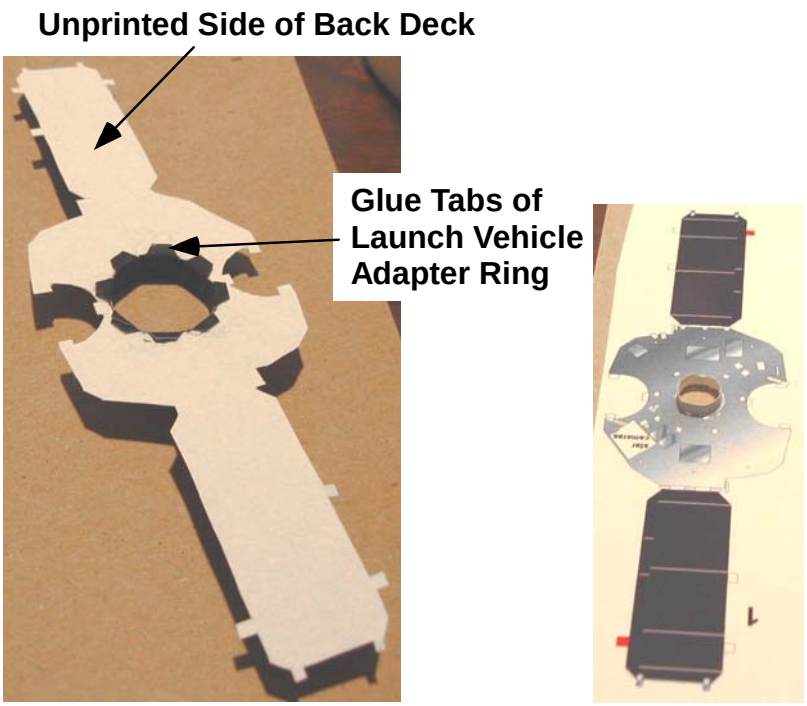



***Figure 2 Gluing the Adapter Rings in Place***

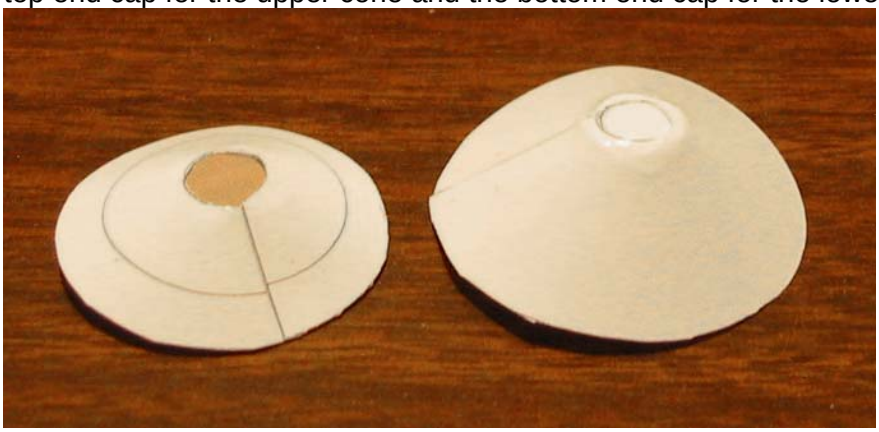
4. Glue the *front* of the body to a piece of thin cardboard, leaving the extra, untrimmed border on the piece for now. (The kind of cardboard that forms the back of a tablet of notebook paper works fine. The whole stack—the cardboard and the two printed sides—should ideally come to about 1/16 inch thick.)

5. After the glue has dried, cut out the front of the body and cardboard together neatly, following the "coastline" of the pattern closely. Then glue the back of the body to the back of the cardboard, being careful to get the large black area that is above the word “battery” on the back underneath the area labeled "star cameras" on the front. (The body is not as symmetrical as it looks. Things won't quite match up right if you have the back turned end-for-end from the way it should be. The solar panel halves that should go together are side by side in the pattern. Again, it is a good idea to let the glue dry with weights applied (being careful not to crush the rings, of course) to minimize warping.

6. Glue the circles you cut out for the rings back where they came from, being careful to get the battery orientation as it was. (You did save an uncut copy, didn't you?). The battery and cameras and "boxes" all fold as boxes. You'll find it easier to get nice square comers if you lightly score the fold lines with a pin. Practice on scrap first, as it is easy to score too deeply and weaken the piece. It also helps to get a sharp fold if you fold over the edge of an Xacto knife blade.

7. The sample-return capsule (see Figures 3 and 4) is made of a top end cap (piece #4) an upper cone (piece #6) a center band (piece #11), a lower cone (piece #5) and a lower end cap (piece #3). The bands have glue tabs along their sides, making them look like centipedes. The band on the sample-return capsule is beveled. The cones have a single glue tab. Form the cones first. Shape the cones by rolling them between your thumb and the barrel of a ballpoint pen to make them nice and round, then glue the glue tab to form a cone with a hole at the top. The glue tab goes inside the cone, and the printing goes on the outside. When the glue dries, apply

glue inside around the hole where the end cap goes. Then insert the end cap from the inside of the cone, printed side toward the hole. Guide it into place with a toothpick. Be sure to use the top end cap for the upper cone and the bottom end cap for the lower cone.



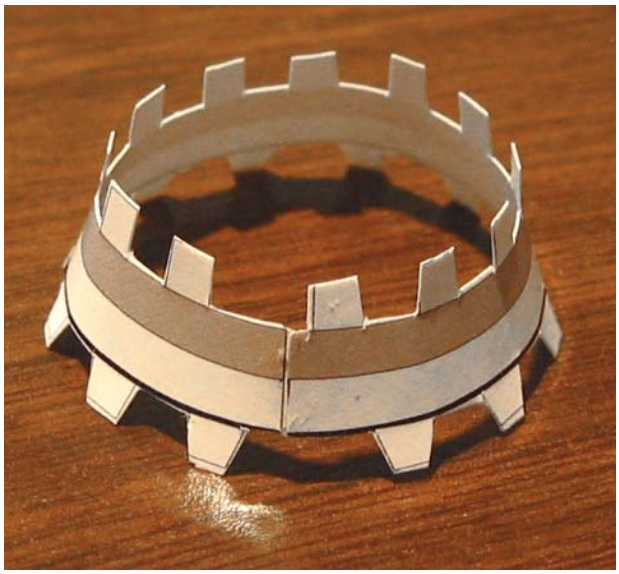


***Figure 3 Sample Return Capsule Assembly, Part 1***

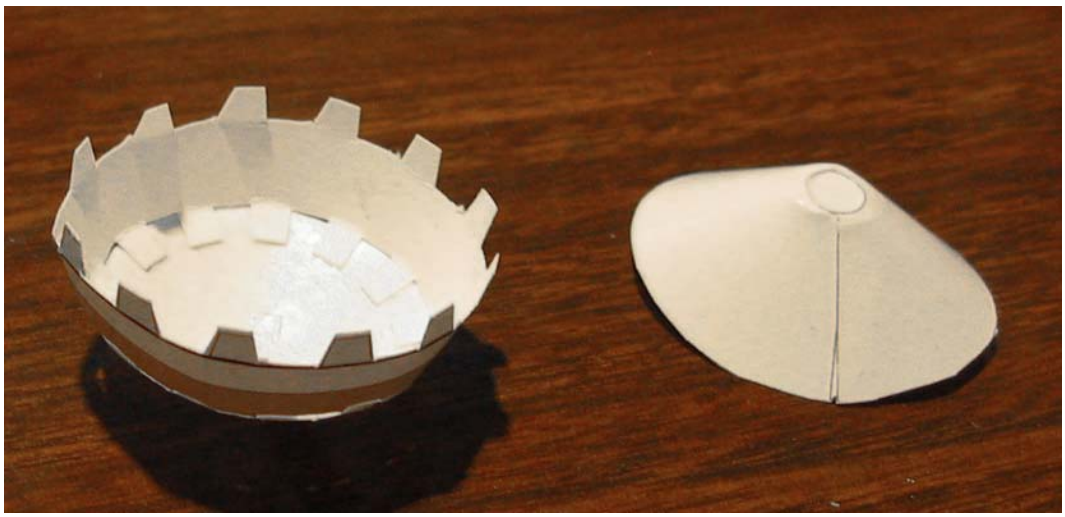


***Figure 4 Sample Return Capsule, Part 2***

8. Form the band that joins the two cones, gluing its end glue tab to the inside (unprinted side) of the piece at the opposite end of the band to form a ring. Glue the glue tabs of the smaller-diameter edge to the inside of the upper cone, then, after the glue dries, glue the glue tabs of the other edge inside the lower cone.

9. The tanks are built just like the sample-return capsule, except that the cones and end caps are interchangeable. One tank is formed from pieces #16 through 20, and the other is formed from pieces #21 through 25. Once the tank end caps are lined up in their holes in the cones, press them firmly into place with the tip of a "click" type ballpoint pen with the refill retracted. Next, form the tank and SRC bands. Bend their glue tabs so that they will fit inside the mating cones, then apply glue to the tabs for one of the cones and glue to that cone. Try to align the joints in the bands with the joints in the cones. Allow the glue to dry before doing the same with the other side.

10. Glue the boxes (pieces #12 through 14) and battery (piece #15) in place. The boxes go on the top deck where there are rectangles of corresponding size. The three boxes are slightly different in size; verify that you're getting them in the right place. The cameras (piece #8) attach to a bracket (piece #7) at their back (gold) end. The bracket is bent in an L shape at the line and glued in the rectangle on the front deck that has the words "star cameras" printed in it. The vertical edge of the bracket goes toward the outboard edge of the rectangle. The cameras then are glued to both the body and the bracket with their hoods (end with black circles) hanging over the edge of the deck and pointing about 10 degrees aft.

11. Make a bead of glue around the sample-return capsule adapter ring and glue the capsule in place, "pointy" bottom (white) end toward the deck.

12. Glue the tanks in place on the sides of the deck in the semicircular cut-out areas reserved for them, trimming the mounting bracket tabs as needed so that the brackets touch the tanks but do not press hard enough to distort their shape. Glue with the “seams” toward the center of the model to hide them as much as possible.

**Web sites:**

http://genesismission.jpl.nasa.gov/mission/craft/index.html
Information about the Genesis Spacecraft

http://www.ast.lmco.com/SSC/gallery/nasaSpace/genesis.shtml
Lockheed Martin’s Product and Image Gallery (Genesis)

**Acknowledgement:**

This paper model was designed by John Tietz who was part of the Genesis attitude control team during the design of the Genesis Spacecraft