



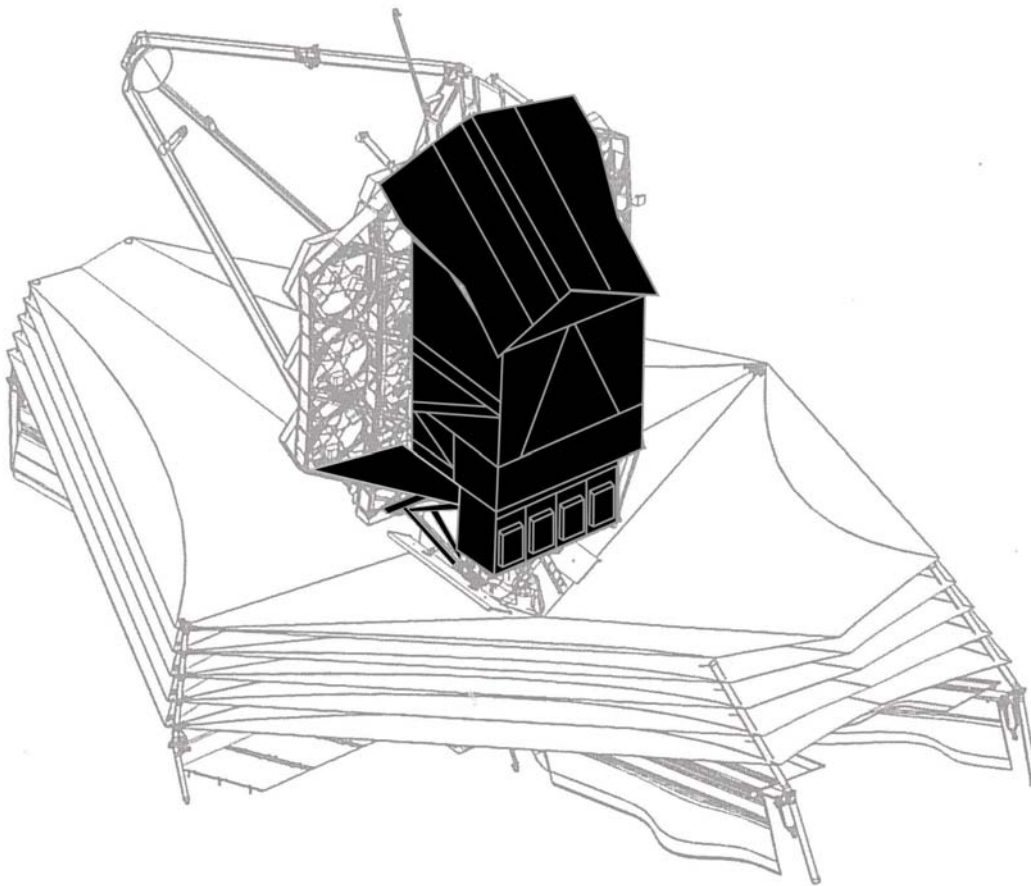
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771



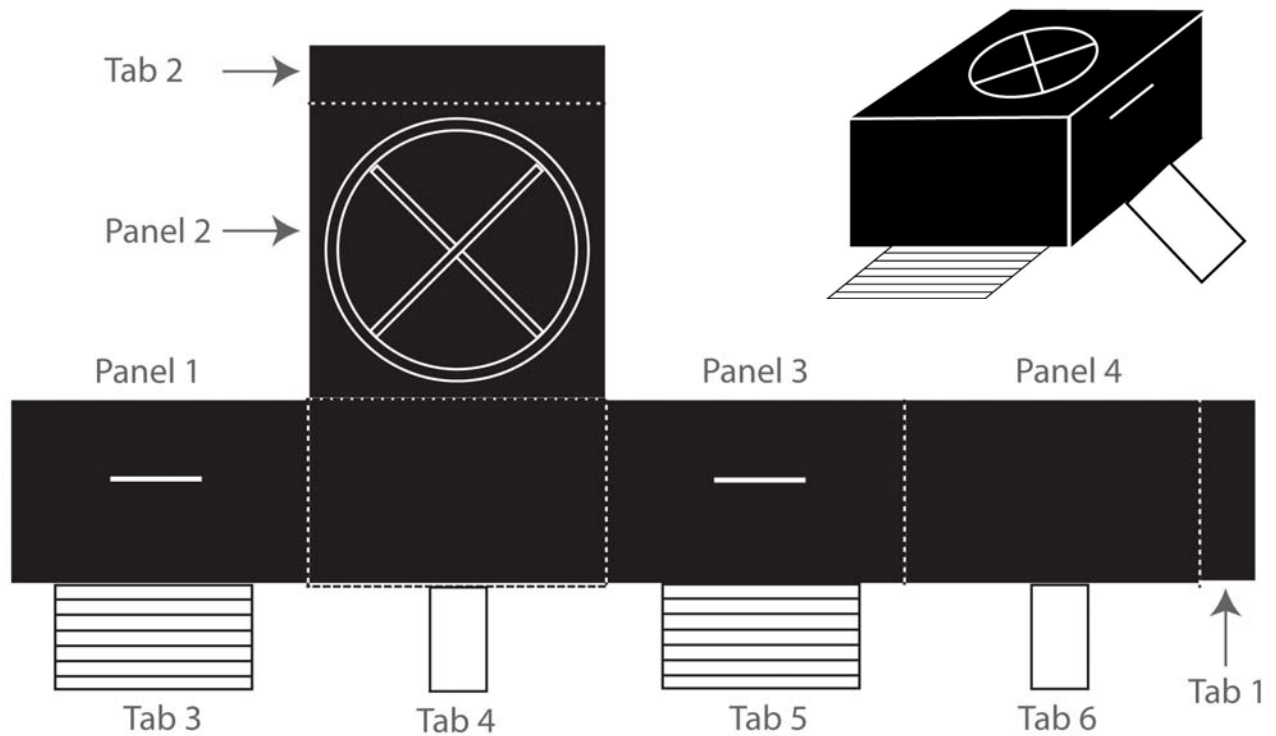
James Webb Space Telescope

Observatory Model

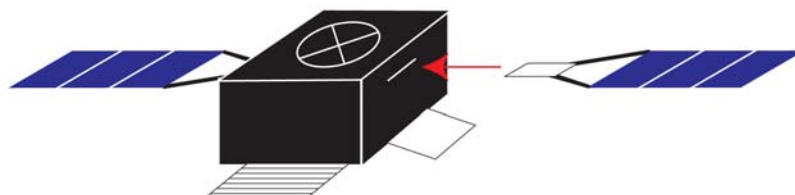
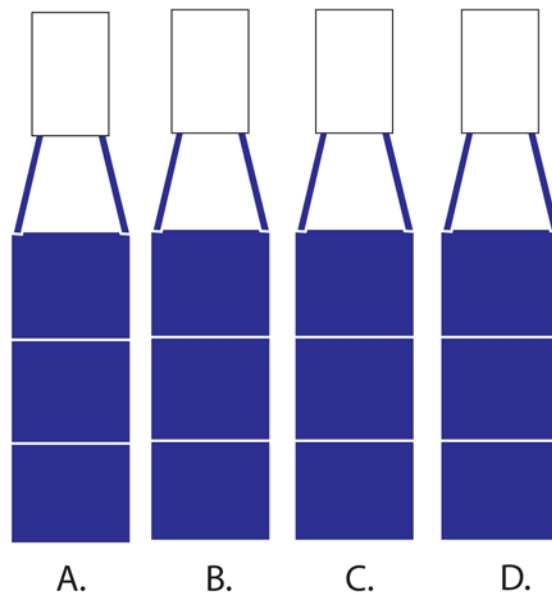
Building Printouts of Assembly Parts



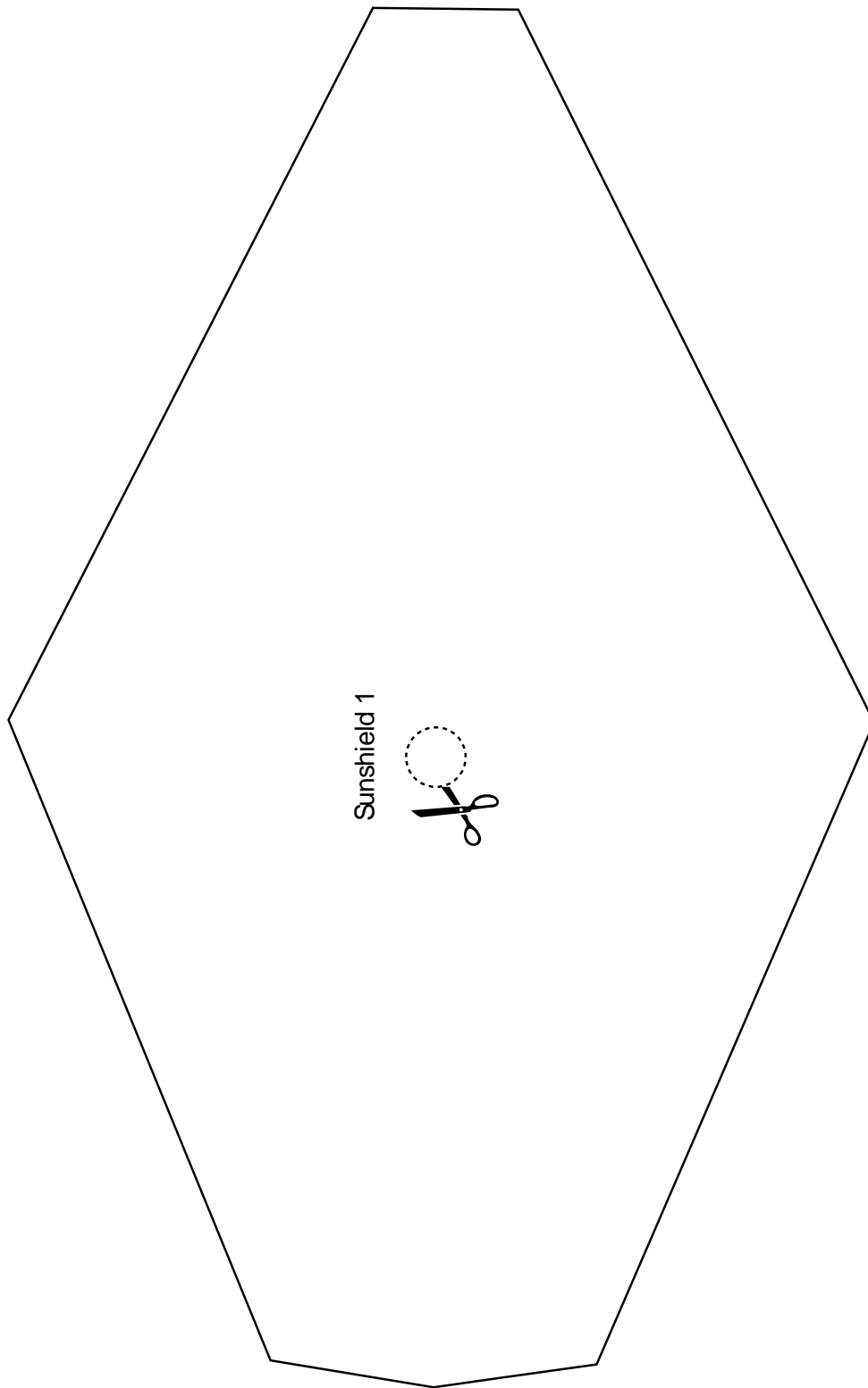
STEP 1: SPACECRAFT BUS ASSEMBLY

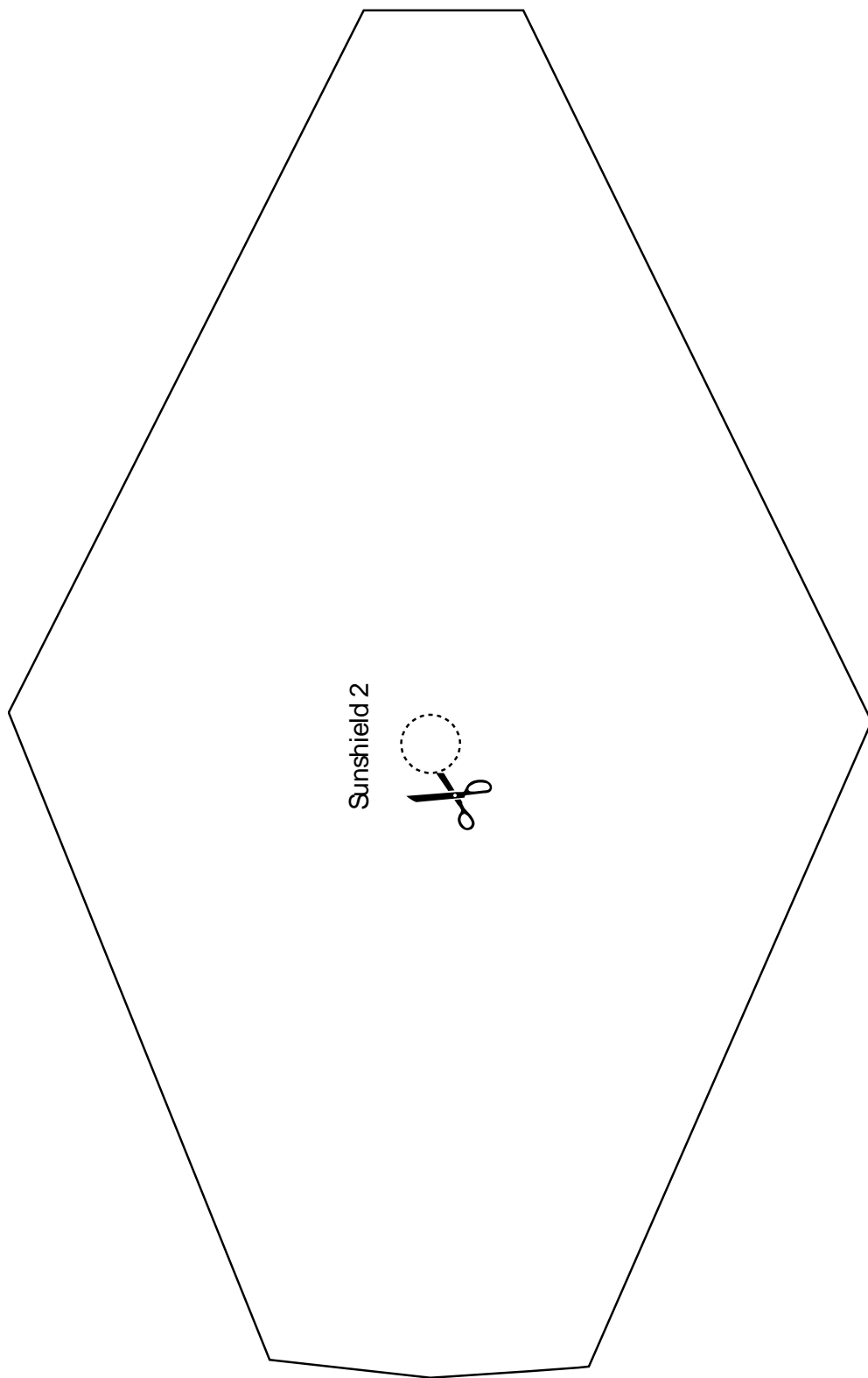


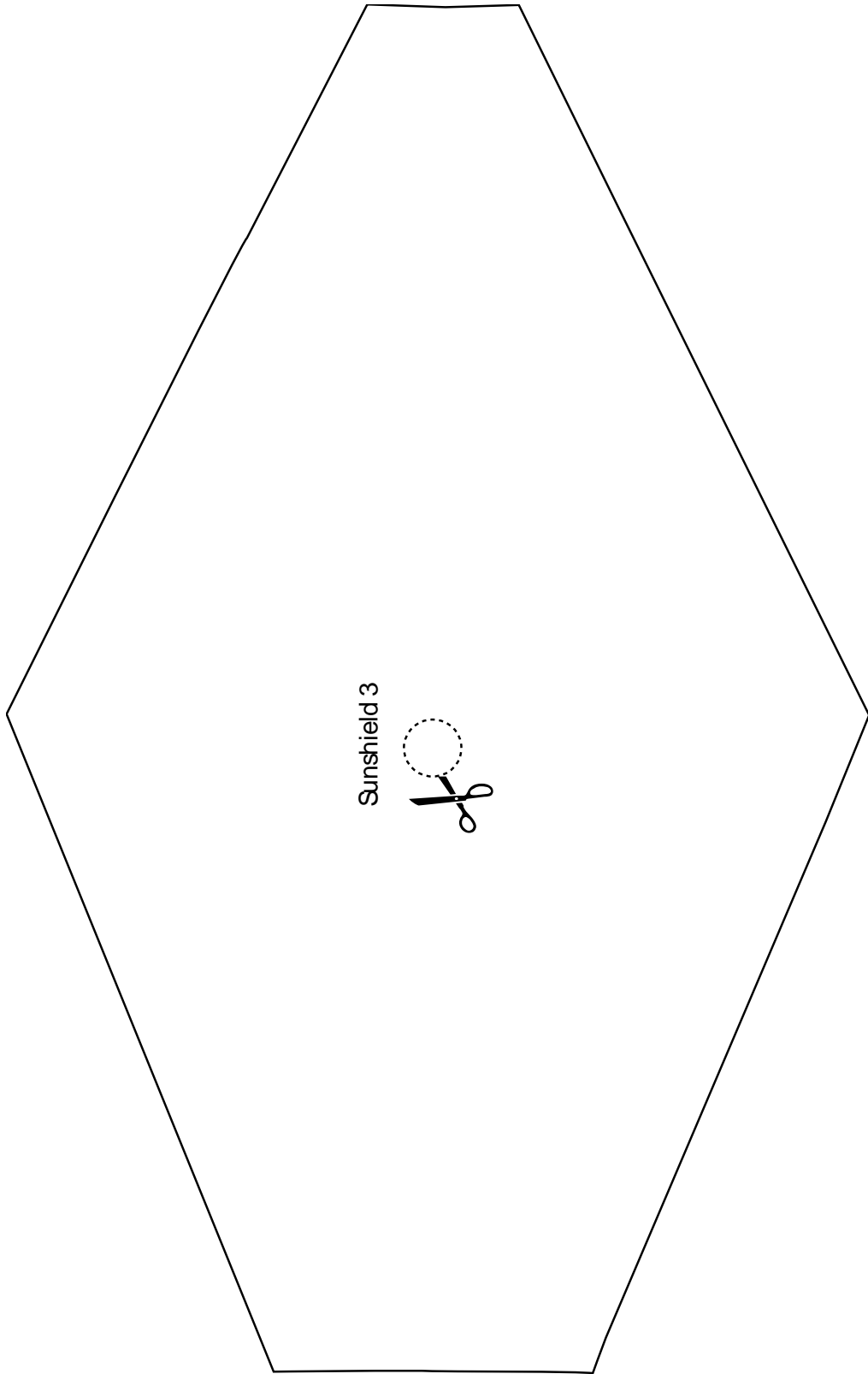
STEP 2: ATTACHING SOLAR ARRAYS

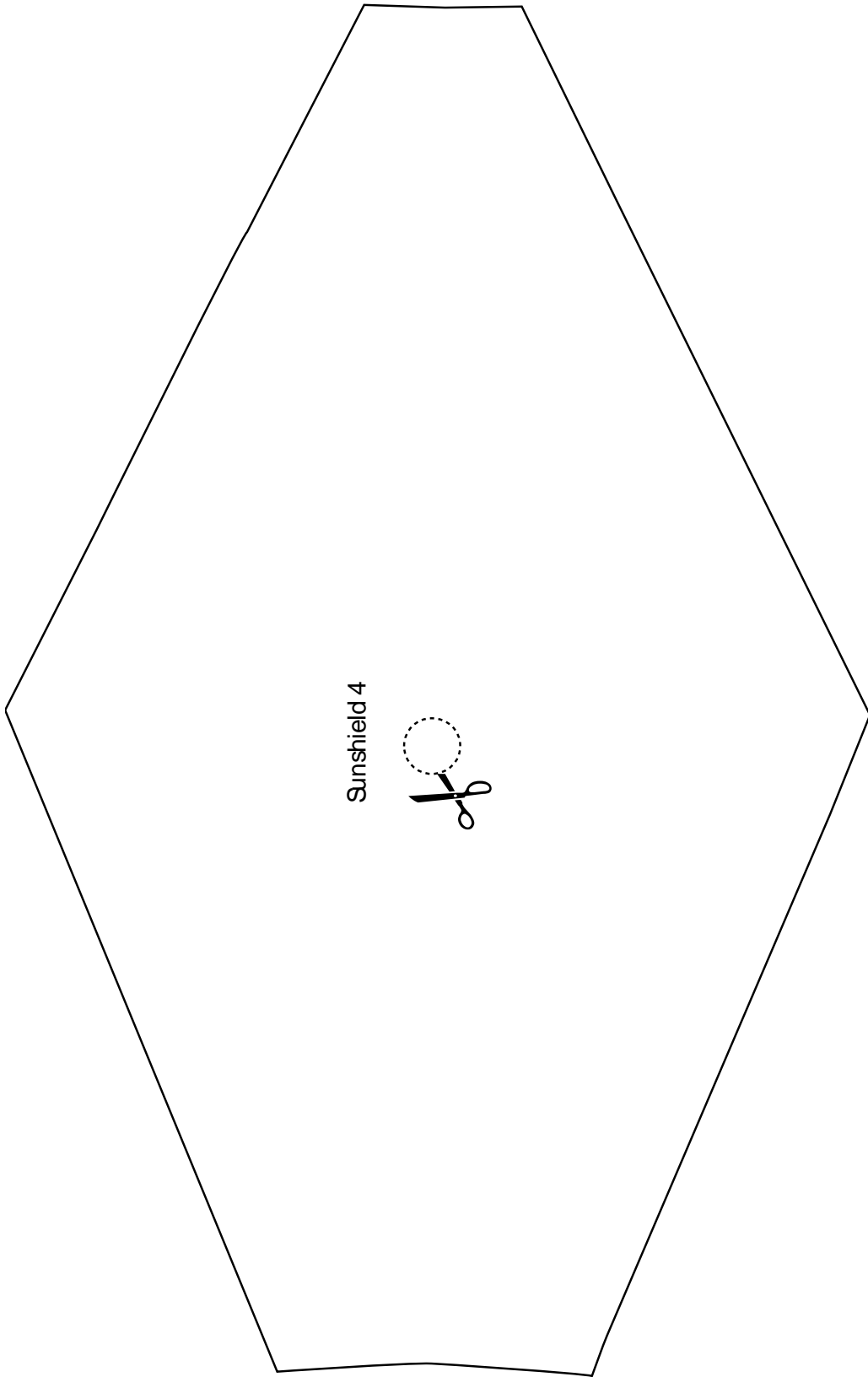


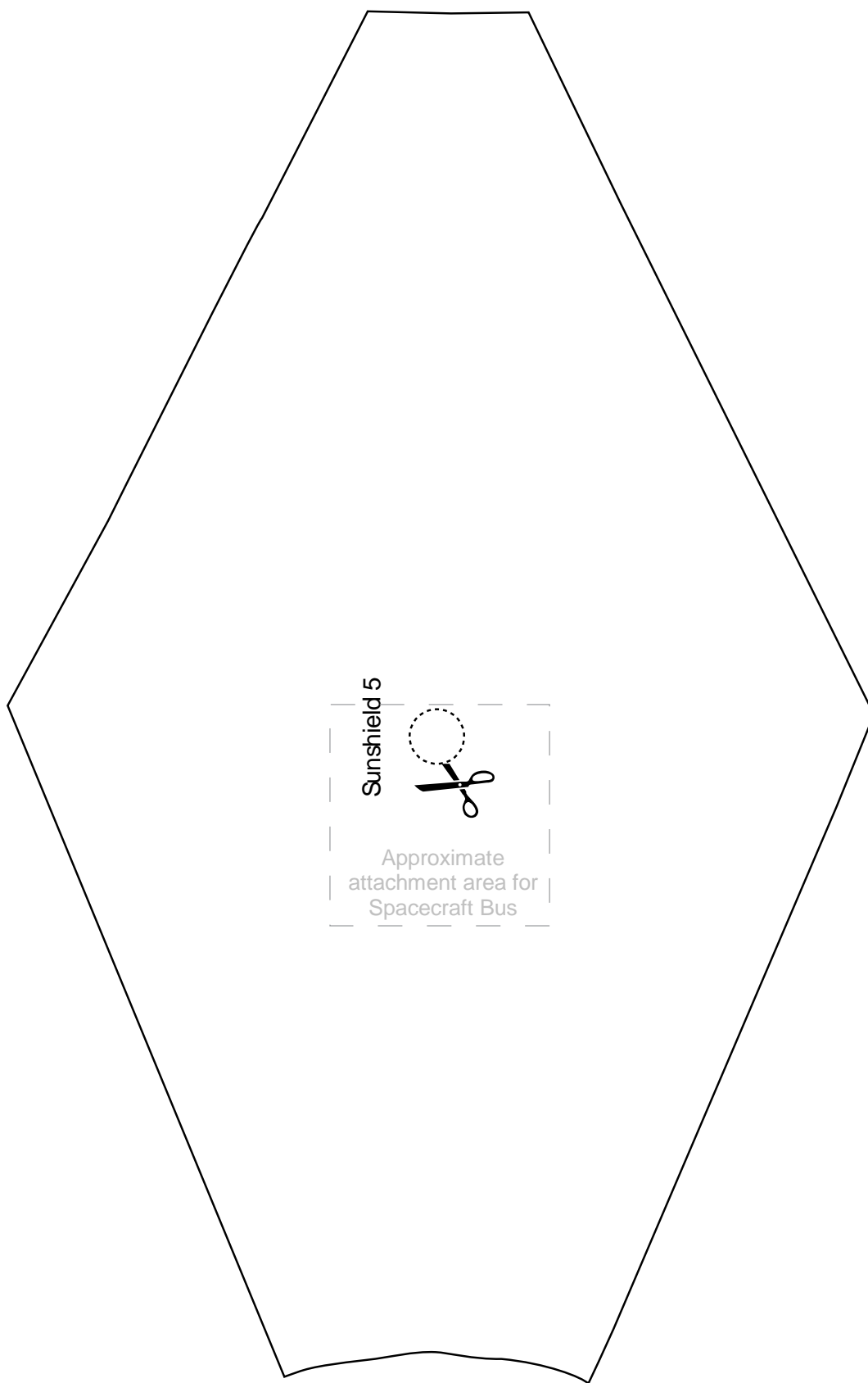
STEP 3: SUNSHIELDS



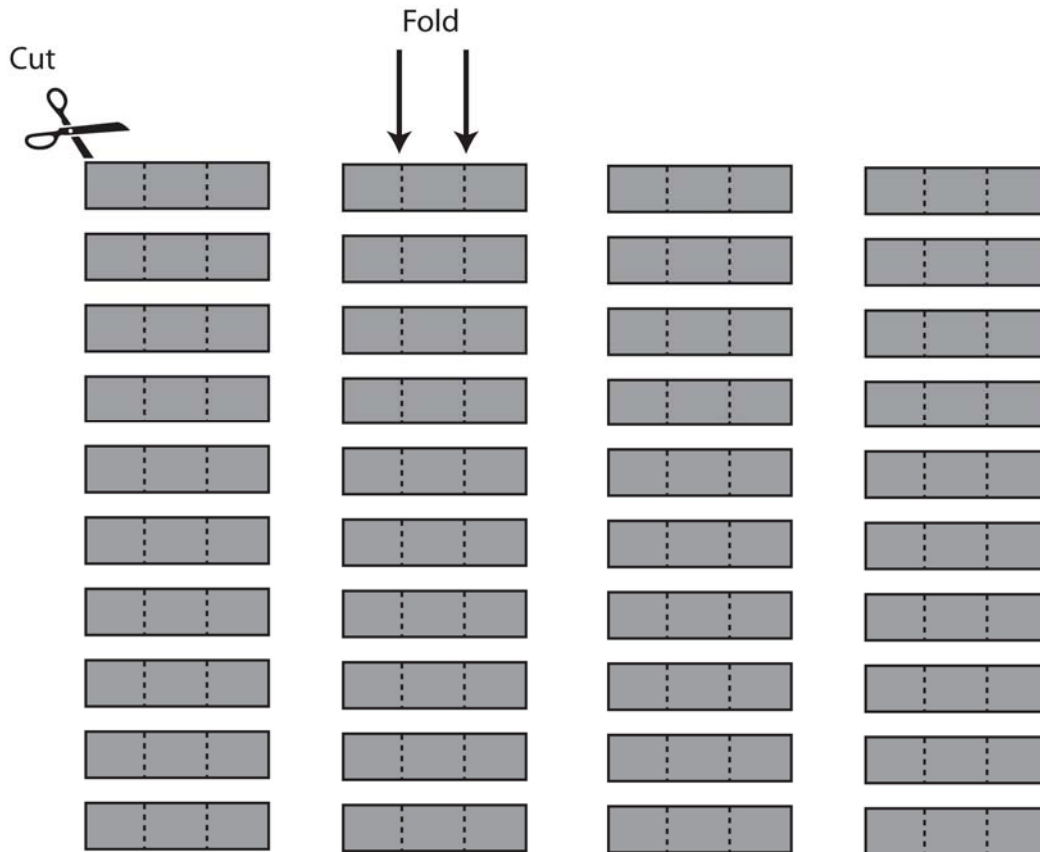








STEP 3: SUNSHIELD TABS

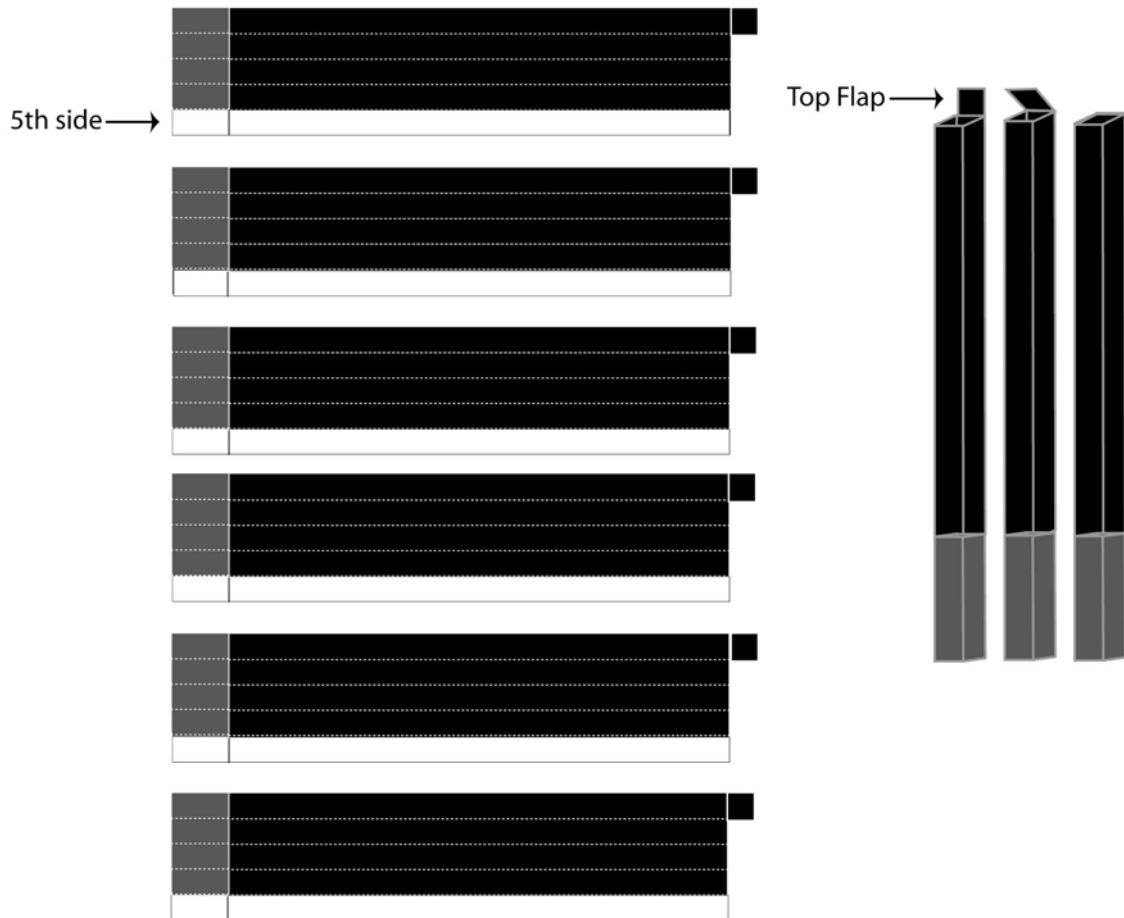


1. Cut out on solid lines
2. Fold inward on dashed lines
so grey shaded side faces outward
as shown in Diagram 1

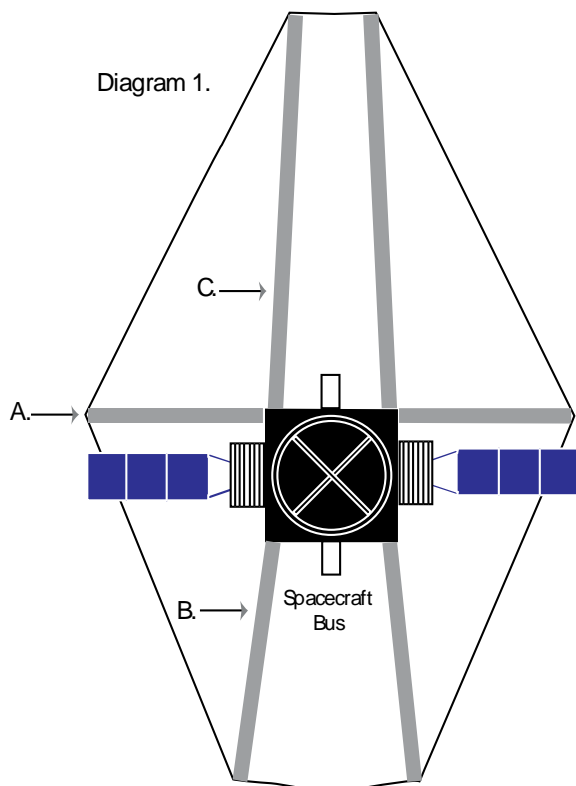
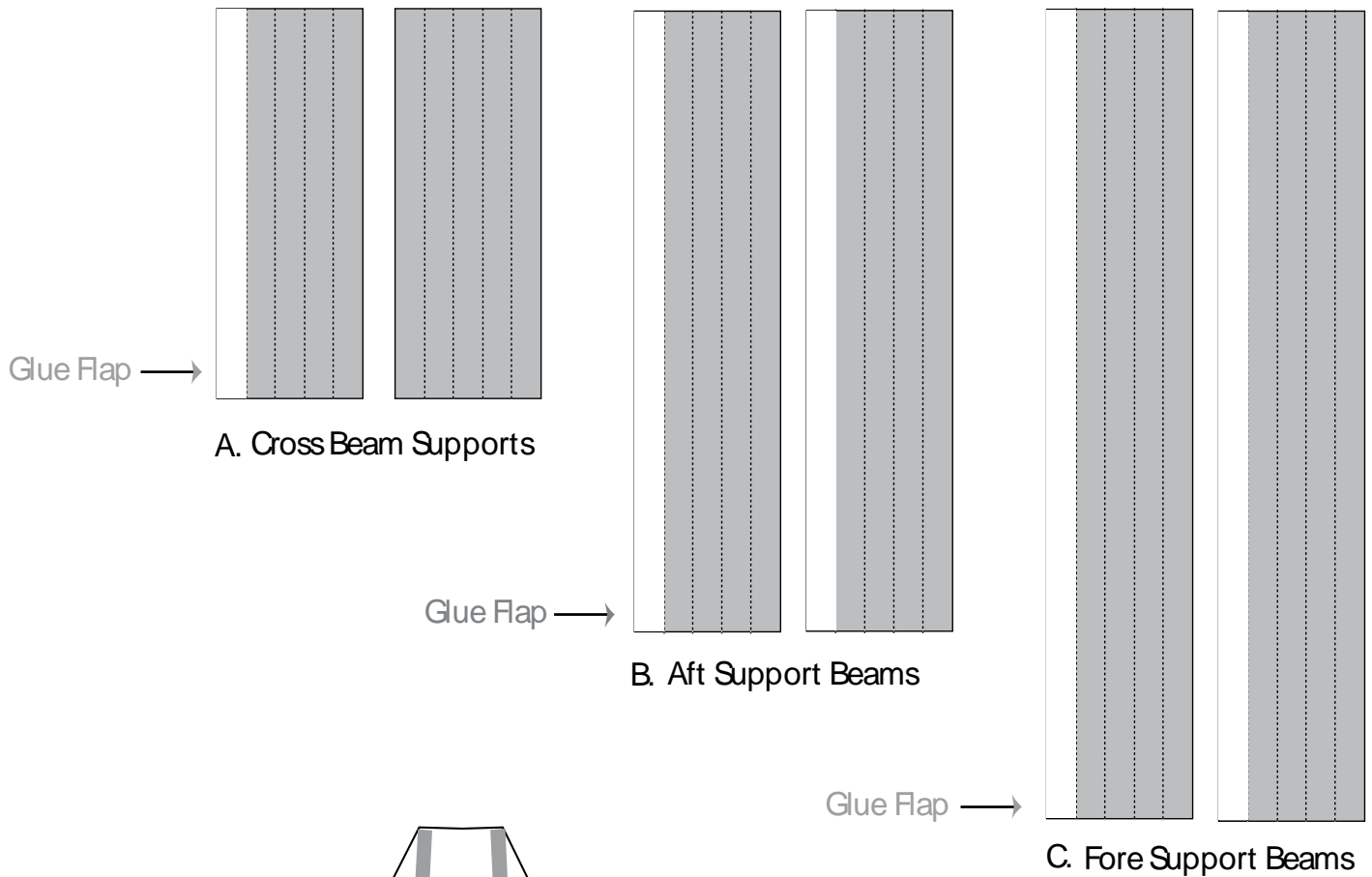
Diagram 1



STEP 3: SUNSHIELD SPREADER BARS



STEP 4: BOTTOM SUNSHIELD SUPPORT BEAMS



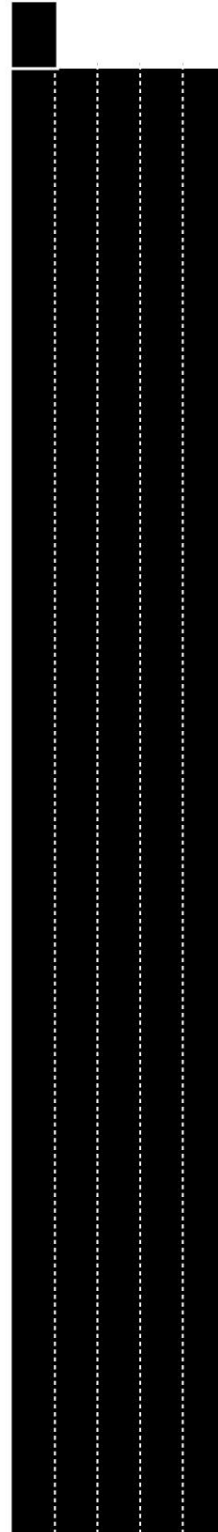
Please Note:
Some trimming of beams may
be necessary for an exact fit
after installing on Sunshield 5

STEP 5: CENTER SUPPORT BOOM

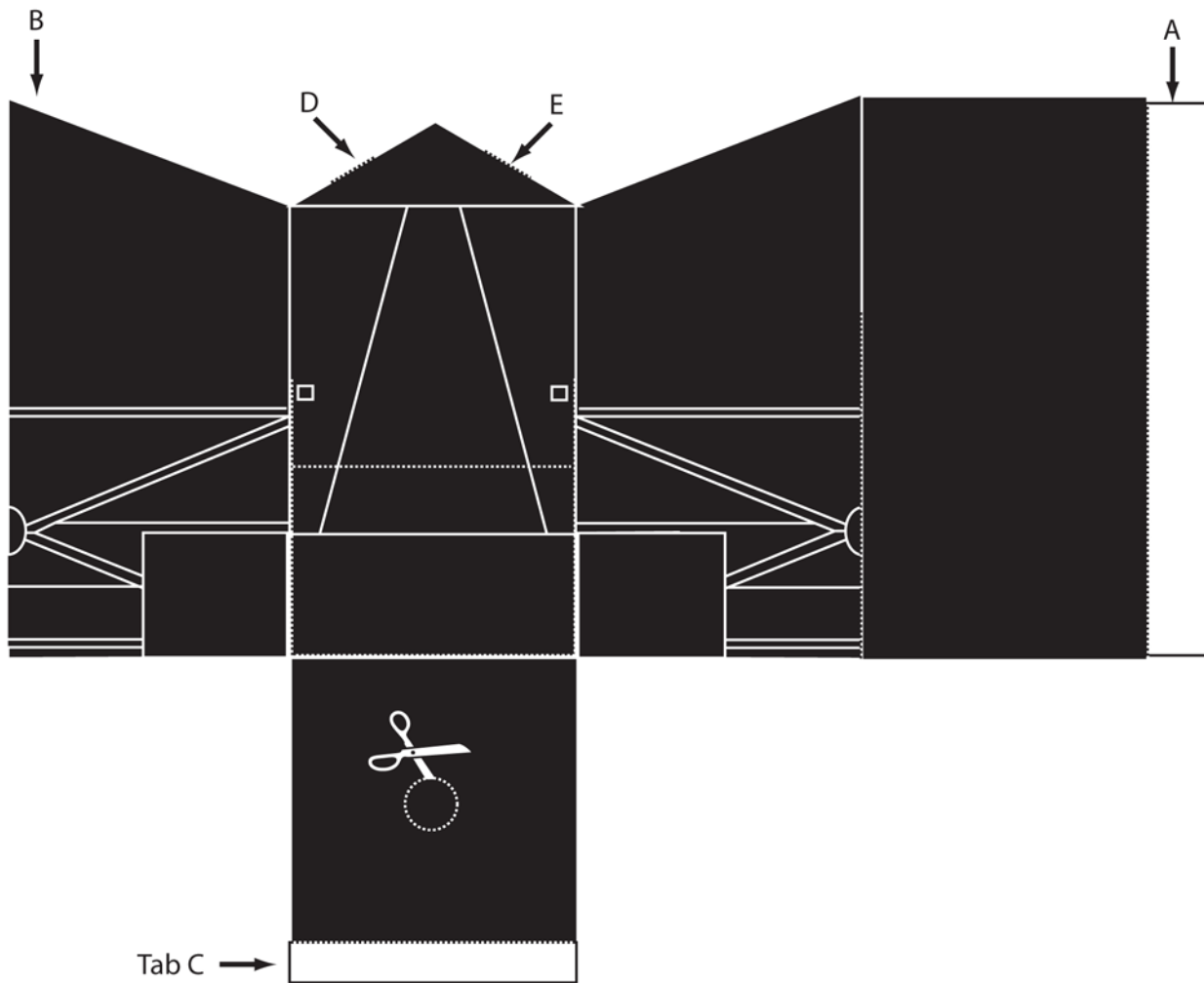
UNSHARPENED NEW PENCIL



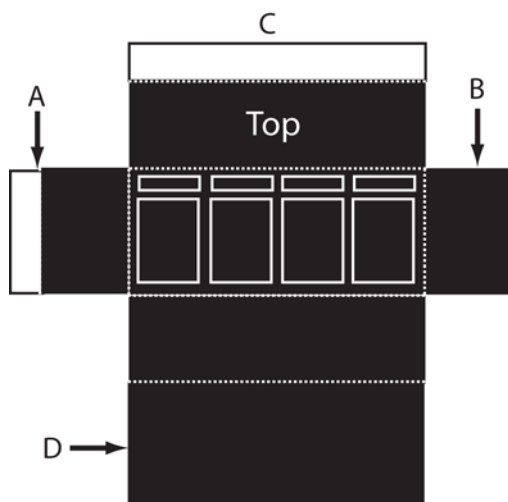
CARDSTOCK CENTER BOOM



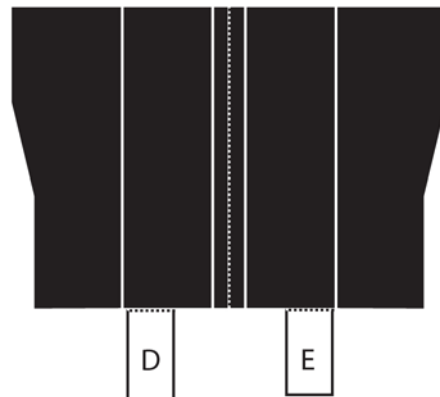
STEP 6: INTEGRATED SCIENCE INSTRUMENT MODULE (ISIM)



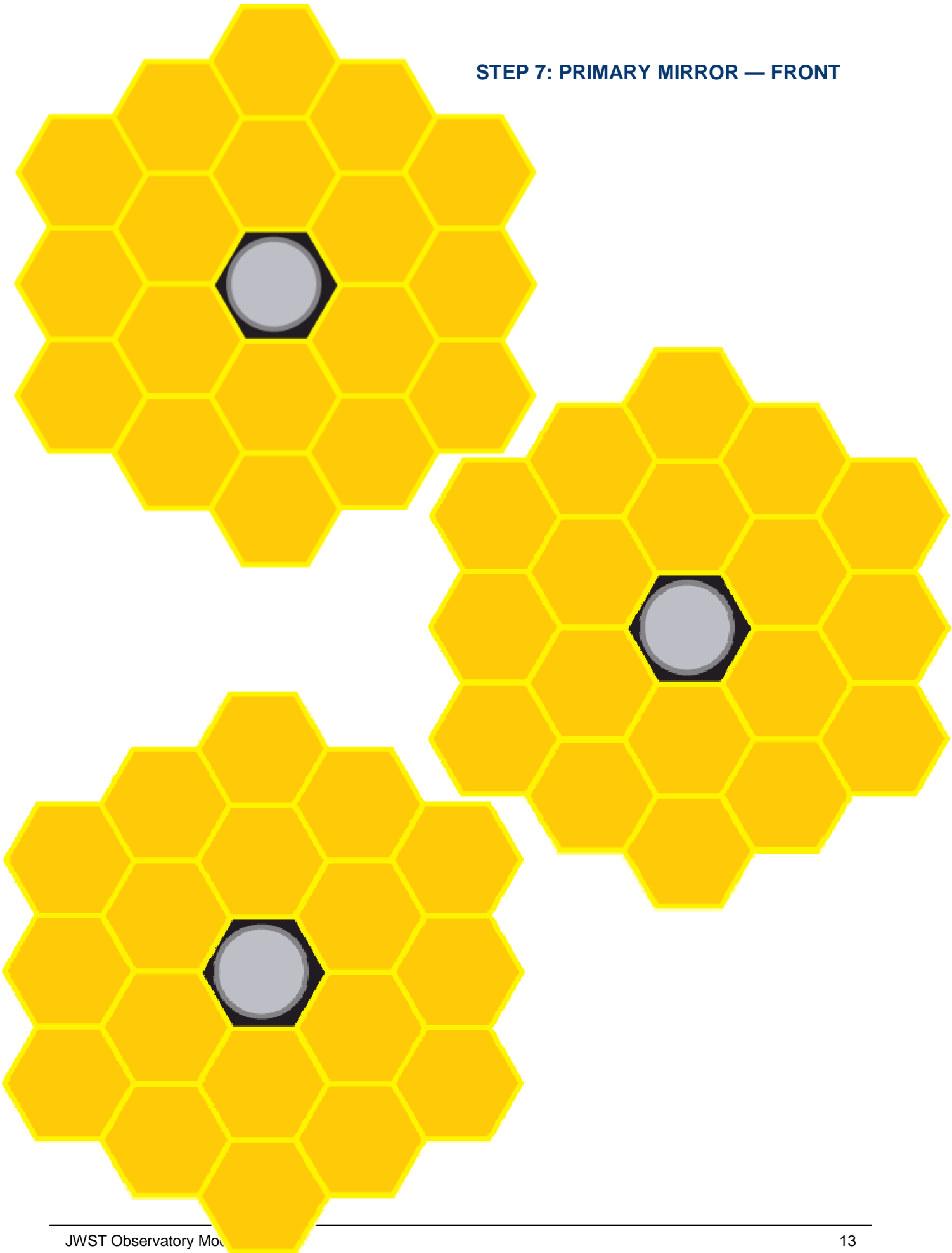
ISIM Electronics Compartment (IEC)



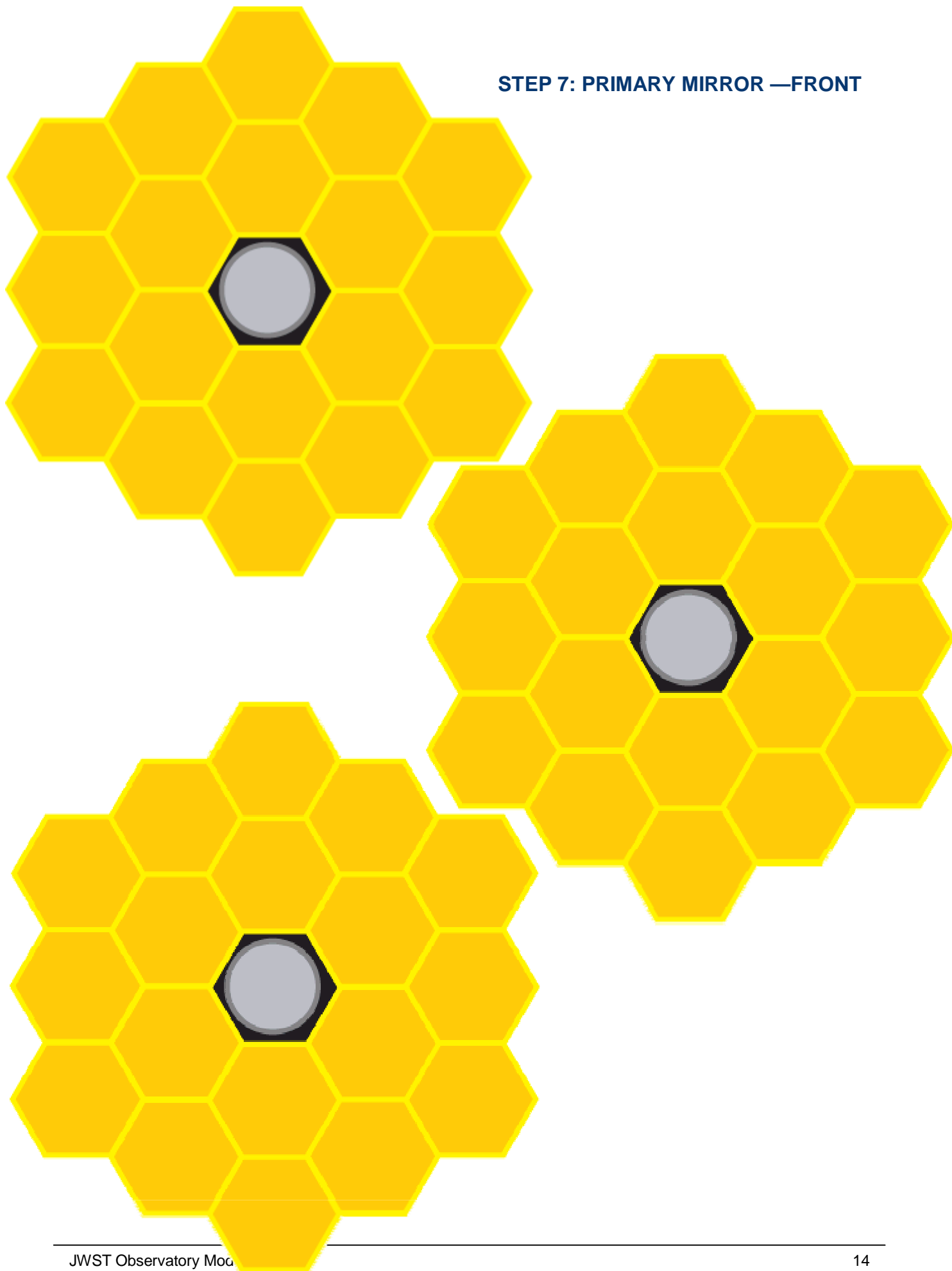
Instrument Shield



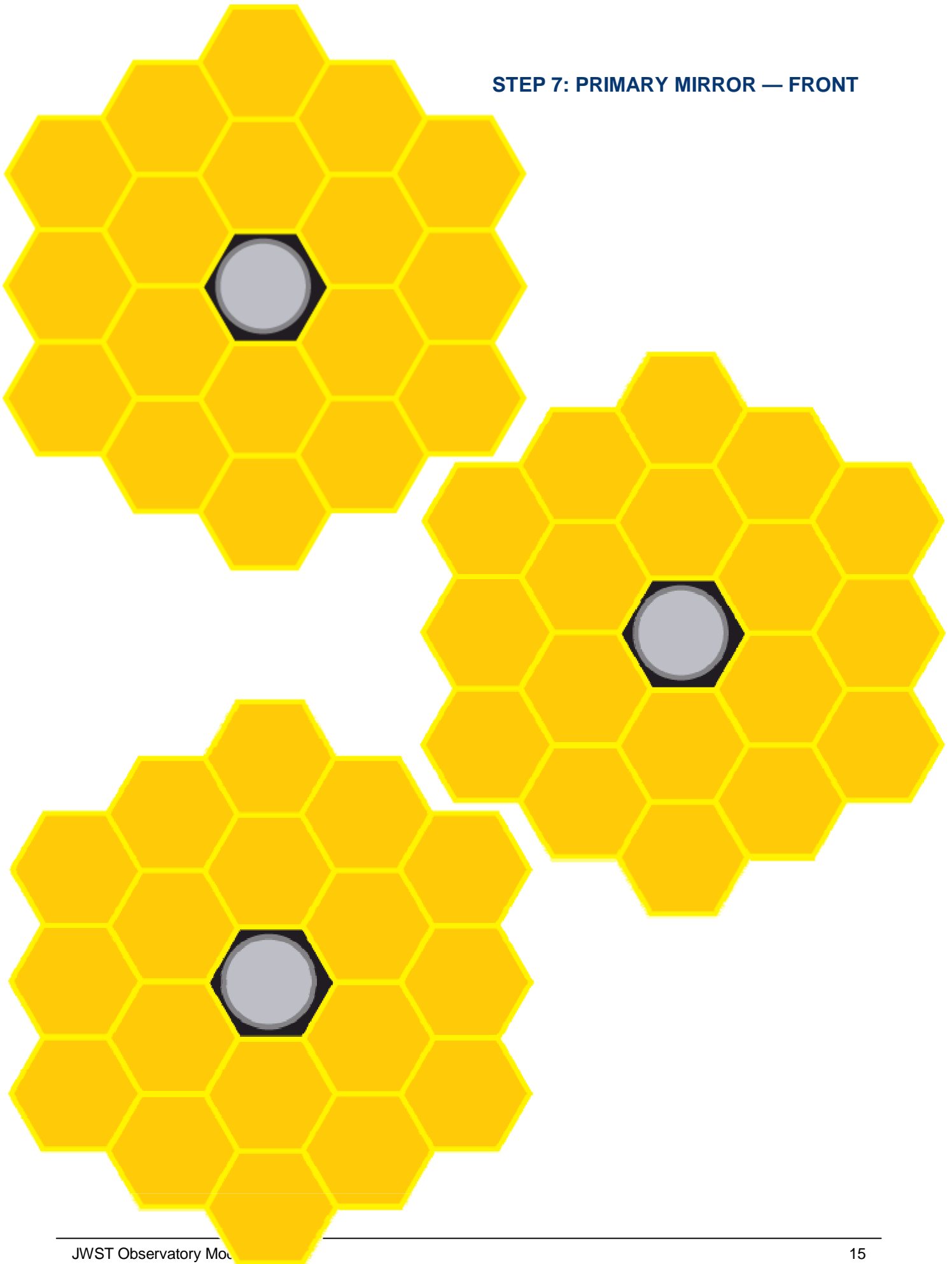
STEP 7: PRIMARY MIRROR — FRONT



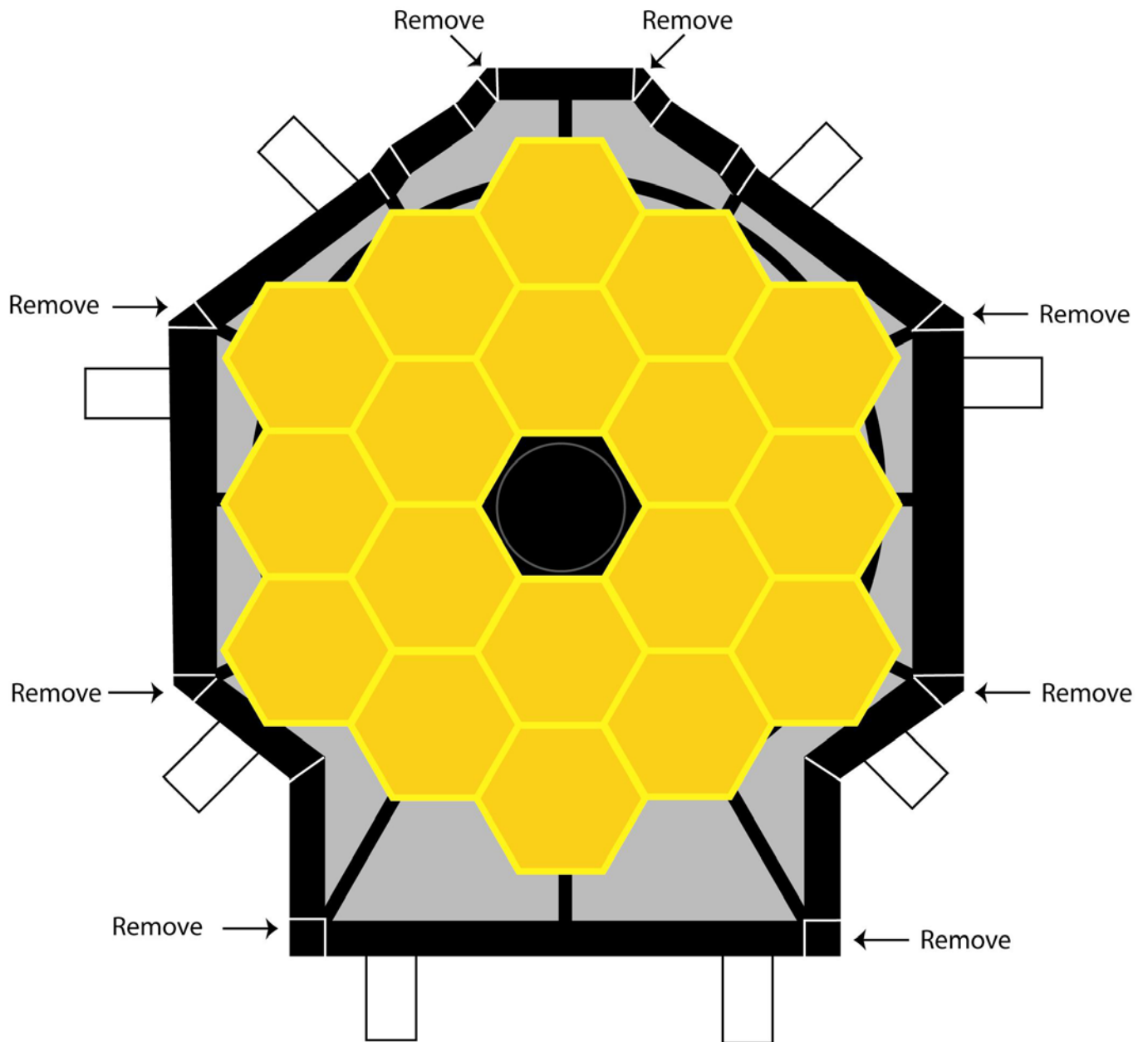
STEP 7: PRIMARY MIRROR —FRONT



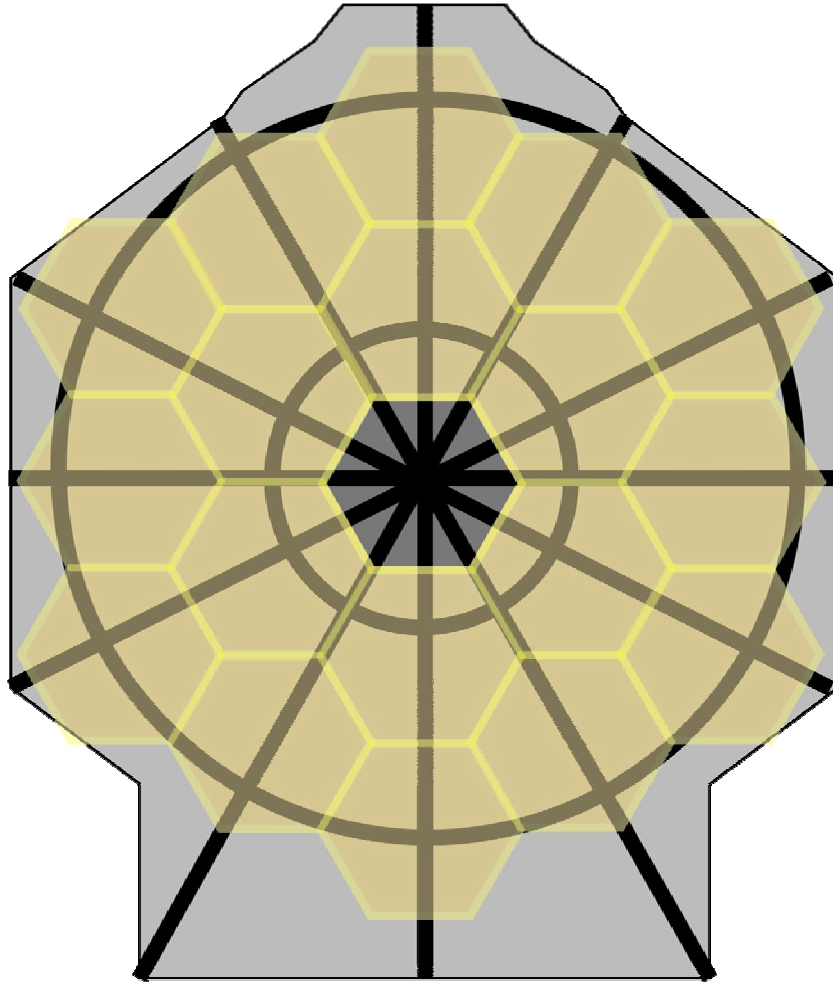
STEP 7: PRIMARY MIRROR — FRONT



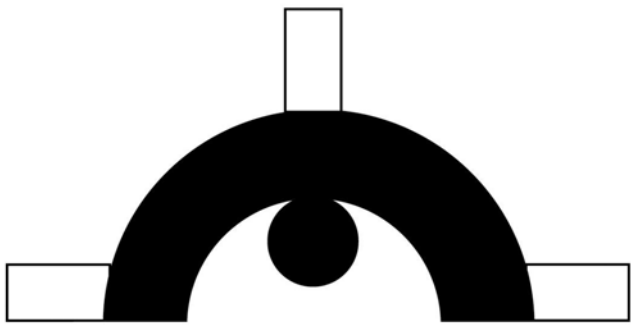
STEP 7: PRIMARY MIRROR — FRONT BACKPLANE STRUCTURE



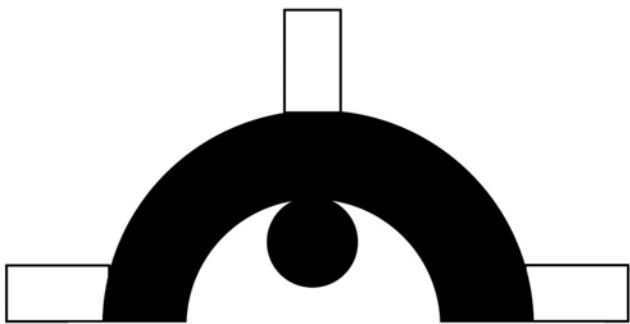
STEP 7: PRIMARY MIRROR — BACK OF BACKPLANE STRUCTURE



STEP 7: SECONDARY MIRROR WITH SUPPORT SYSTEM BOOMS

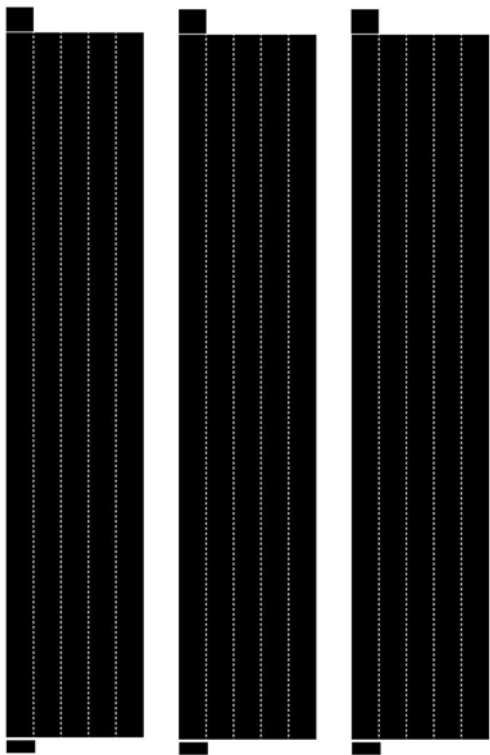


Aft Optics System



STEP 9

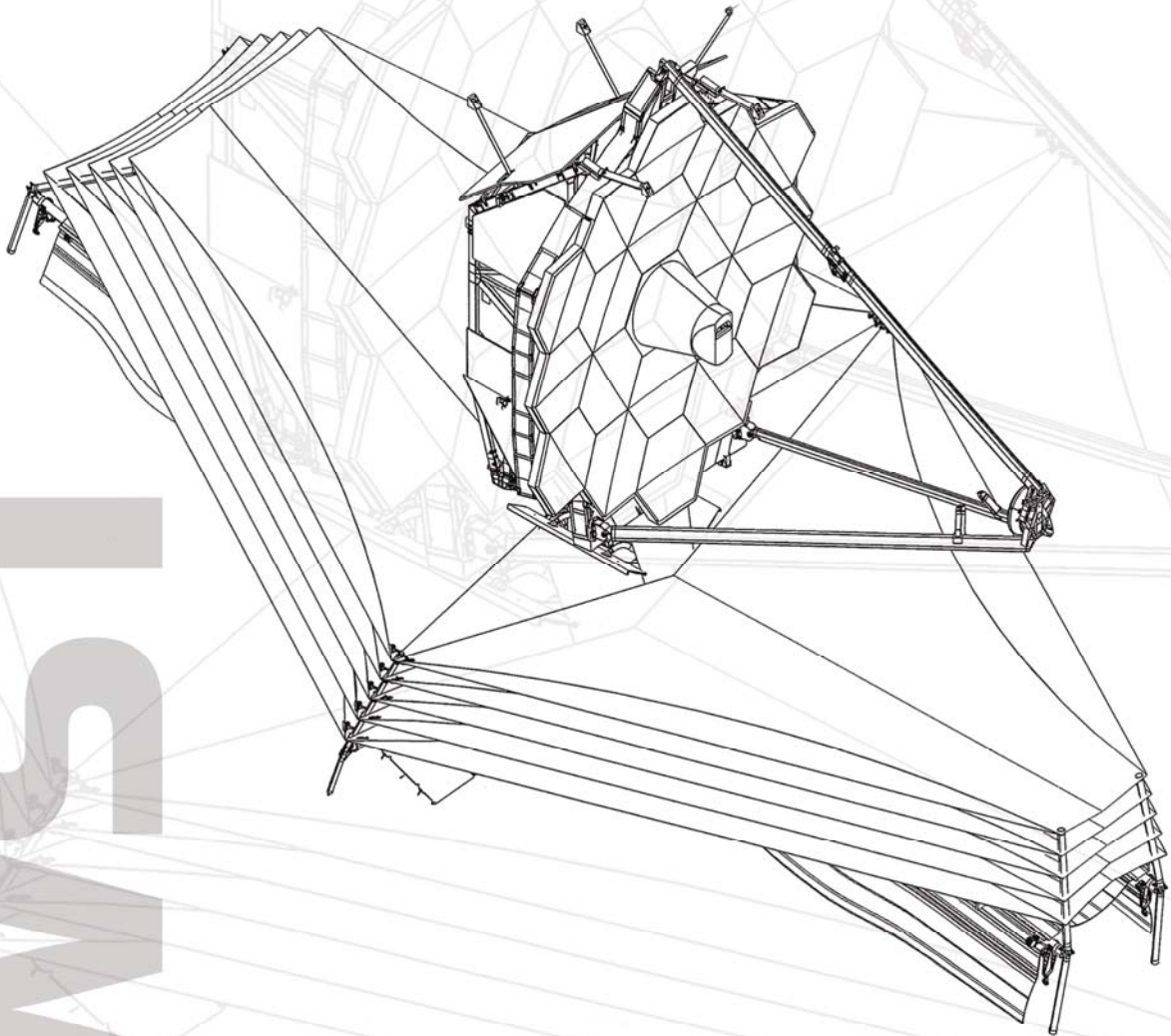
Secondary Mirror Assembly



Secondary Mirror Support
System Booms



James Webb Space Telescope Observatory Model





National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771



James Webb Space Telescope

Observatory Model

Building Instructions

OVERVIEW

This model is designed to help students understand the operation of the James Webb Space Telescope.

Throughout the assembly of this model, students and model enthusiasts will encounter different phases of development and assembly of the spacecraft.

OBJECTIVES

- To develop and understand the purpose of each part
- To see clearly how all the parts fit together
- To learn about the First Light Objects, Galaxy Assembly, Birthplaces of Stars, and Evolution of Planetary Systems, and Life Support
- To work in teams to accomplish the above objectives

Supplies

6TH GRADER AND UNDER

The supplies needed for building this project are:

1. Color Printer (preferably) or black and white is okay; one that can print on card stock
2. 1 package 110# white card stock (available at office supply stores)
3. Standard bond printer paper
4. OR go to your local copy or office supply store and have them print out the file to save on buying full packages of white card stock or standard bond printer paper
5. Standard #2 Pencil
6. Children's scissors (pointed-end type)
7. Elmer's Glue
8. Scotch Tape
9. 12 inch Plastic Ruler
10. Safe surface and place with plenty of room to cut out paper parts and assemble them with space to allow glued pieces to dry
11. Paper towels or wet naps to wipe glue from fingers
12. Popsicle sticks (can be used to apply Elmer's Glue on small parts and to remove excess up glue)

7TH GRADERS AND UP

1. Color Printer (preferably) or black and white is okay; one that can print on card stock
2. 1 package 110# white card stock (available at office supply stores)
3. Standard bond printer paper
4. OR go to your local copy or office supply store and have them print out the file to save on buying full packages of white card stock or standard bond printer paper
5. Mini Hot Glue Gun

6. Mini Hot Glue Sticks (twelve – 4 inch sticks)
7. Thin crafting shears (very sharp and precise scissors, available at arts and crafts stores)
8. X-Acto knife (use with supervision if necessary)
9. Five extra X-Acto knife #11 blades
10. 12 inch metal ruler
11. Paper towels or wet naps to wipe glue from fingers
12. Safe surface and place with plenty of room to cut out paper parts and assemble them with space to allow glued pieces to dry

SAFETY CONSIDERATIONS FOR K THROUGH 6TH GRADERS – USE CAUTION:

1. When cutting with scissors
2. Using Scotch Tape – watch the jagged edges on the end of the tape dispenser
3. Paper cuts

SAFETY CONSIDERATIONS FOR 7TH GRADERS AND UP – USE CAUTION:

When cutting with scissors / X-Acto knife and using a hot glue gun

TIME CONSIDERATIONS

This model takes approximately 2 – 4 hours to build. So be patient! It's worth it!

Getting Started

6TH GRADERS AND UNDER

1. Print out JWST Model Instructions file on regular copy bond paper for reference as you cut out and assemble the parts.
2. Print out JWST Model Parts on the card stock.
3. Have supplies ready to cut out the pieces.
4. Cut out and assemble one part at a time in the order of the instructions and parts.
5. Assemble each piece using either tape or Elmer's Glue or a combination of both. Use what is easiest for you to work with.
6. Let each assembled part dry completely before attaching to next part. When using Elmer's Glue, it may take up to ½ hour to dry.
7. You can assemble certain parts while others are drying.
8. Clean up as you go along to keep things in order.

7TH GRADERS AND OVER

1. Print out JWST Model Instructions file on regular copy bond paper for reference as you cut out and assemble the parts.
2. Print out JWST Model Parts on the card stock.
3. Insert a new glue stick into the mini hot glue gun.
4. Heat up mini hot glue gun. This takes about 5 minutes.
5. Have supplies ready to cut out the pieces.
6. Cut out and assemble one part at a time in the order of the instructions and parts.
7. Use X-Acto knife and metal ruler to score in specified places.
8. Fold over scores carefully.
9. Assemble each piece using either tape or hot glue gun or a combination of both. Use what is easiest for you to work with.
10. Let each assembled part dry completely before attaching to next part.

11. You can assemble certain parts while others are drying.
12. Clean up as you go along to keep things in order.



Youth Supplies



Adult Supplies

List of Cutouts / Parts

Cutouts included in this assembly booklet:

- Integrated Science Instrument Module (ISIM) (1)
- ISIM Electronics Compartment (IEC) (1)
- ISIM Instrument Shield (1)
- Spacecraft Bus Assembly and diagram (1)
- Solar Arrays (2) and assembly diagram
- Sunshields (5)
- Sunshield Tabs (40) and diagram — there are extra tabs
- Sunshield Spreader Bars (6) and diagram
- Bottom Sunshield Support Beams (6) and diagram
- Primary Mirror with extra for printing multiple copies
- Primary Mirror – Front Backplane Structure (1)
- Primary Mirror – Back of Backplane Structure (1)
- Diagram of #2 Pencil for Center Support Boom (1)
- Cardstock version of Center Support Boom (1)
- Secondary Mirror – Aft Optics System (1)
- Secondary Mirror – OTE Secondary Mirror assembly (1)
- Secondary Mirror Support System Booms (3)

Assembly Instruction Pages

NOTE: Read the directions **COMPLETELY** before you start in order to familiarize yourself with the parts and final assembly.

1. Assembly of Spacecraft Bus (1)
2. Assembly of Solar Arrays (2)
3. Assembly of Sunshields (5) and Spreader Bars (6)
4. Attach Spacecraft Bus to bottom of Sunshield 5
5. Attach ISIM Instrument to Center Support Boom (1)
6. Assembly of ISIM and EIC (1) – Diagram of ISIM Structure Assembly
7. Assembly of Primary Mirror – Front and Back (1)
8. Attach Primary Mirror Assembly to Center Support Boom (1)
9. Assembly of the Secondary Mirror with Support System Booms (1)
10. Photo of completed JWST Observatory model

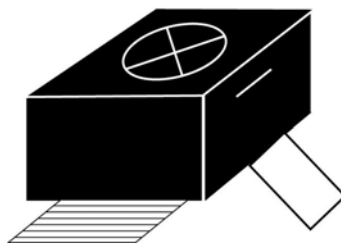
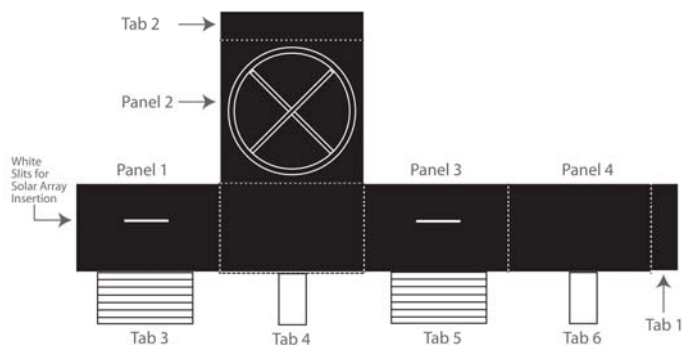
Step 1: Assembly of Spacecraft Bus

1.1 SPACECRAFT (S/C) BUS

1. Cut out Spacecraft Bus along outside edges
2. Score with scissors or X-Acto knife on dotted lines

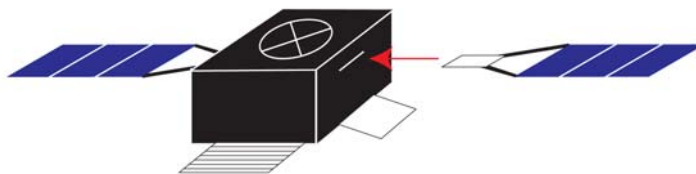
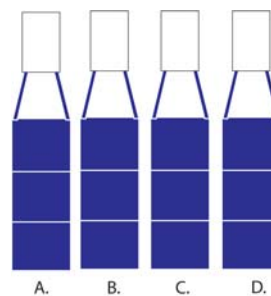
Score = to lightly cut; do not cut all the way through paper

3. Cut white slits in side of S/C bus in panels 1 and 3 for insertion of solar array tabs
4. Fold panels 1, 3, and 4 inward on each dotted line to form a box shape
5. Fold tab 1 inward and glue to inside of panel 1
6. Fold panel 2 on dotted line
7. Fold tab 2 on dotted line and glue to inside of box on panel 4
8. Fold tabs 3 – 6 outward from box



Step 2: Assembly of Solar Arrays

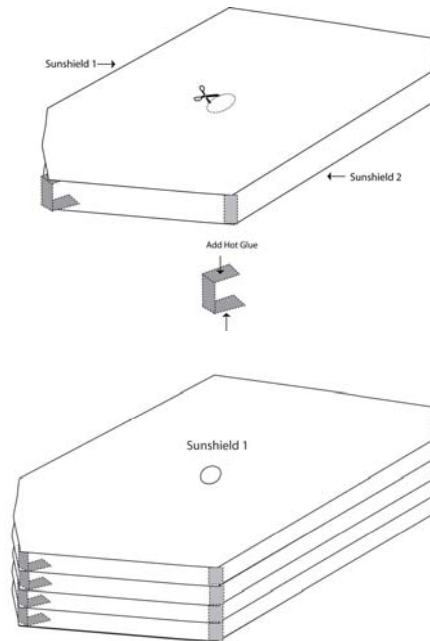
1. Trim out solar arrays
2. Glue A and B back-to-back to create a double-sided array
3. Glue C and D to make another double-sided array
4. Insert white tabs on solar arrays into slits in panel 1 and 3 of spacecraft bus
5. Glue tabs to inside of S/C bus to hold arrays in place
6. Unit will be attached to bottom of sunshield in Step 4.1



Step 3: Assembly of Sunshields and Spreader Bars

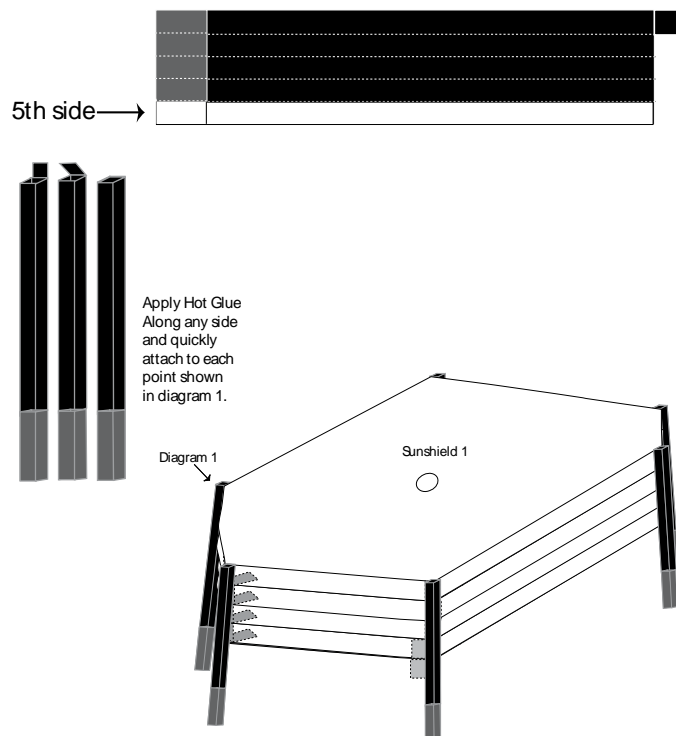
3.1 SUNSHIELDS

1. Cut along edge of sunshield; cut out 5 sunshields
2. Cut out center circles with small scissors or X-Acto knife
3. Cut out tabs so each is separate
4. Fold along dotted lines to create a 3-sided tab
5. Glue or tape tabs and attach to each sunshield until all 5 Sunshields are stacked evenly (neatness counts!)



3.2 ASSEMBLING THE SUNSHIELD SPREADER BARS

1. Trim on solid black lines
2. Score on dotted Lines
3. Fold lengthwise on each dotted line
4. Tuck 5th side in to form a box shape
5. Run glue along inside of flap 5
6. Fold over and press closed to create box shaped bars



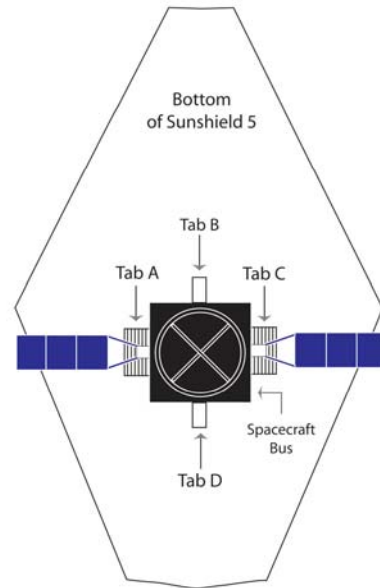
3.3 ATTACHING THE SUNSHIELD SPREADER BARS

1. Apply glue along any side of spreader bar and attach to each point shown in Diagram 1
2. Repeat to attach remaining bars as shown in illustration

Step 4: Attach Spacecraft Bus to bottom of Sunshield 5

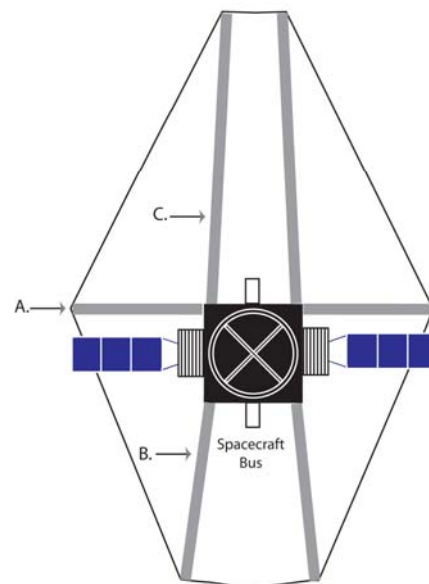
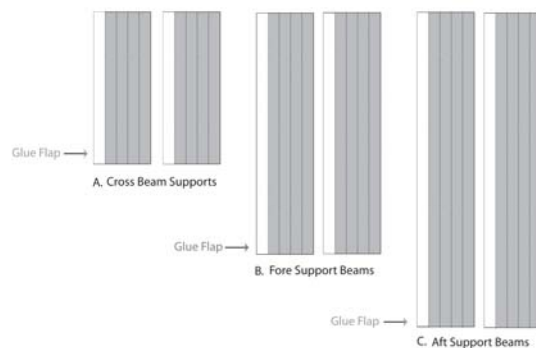
4.1 ATTACH SPACECRAFT BUS TO BOTTOM OF SUNSHIELD 5

1. Turn sunshield structure over to begin adhering the Spacecraft bus
2. Fold tabs of S/C bus outward
3. Line S/C bus to dotted box on bottom of Sunshield 5
4. Glue tabs to Sunshield



4.2 ASSEMBLING BOTTOM SUNSHIELD SUPPORT BEAMS

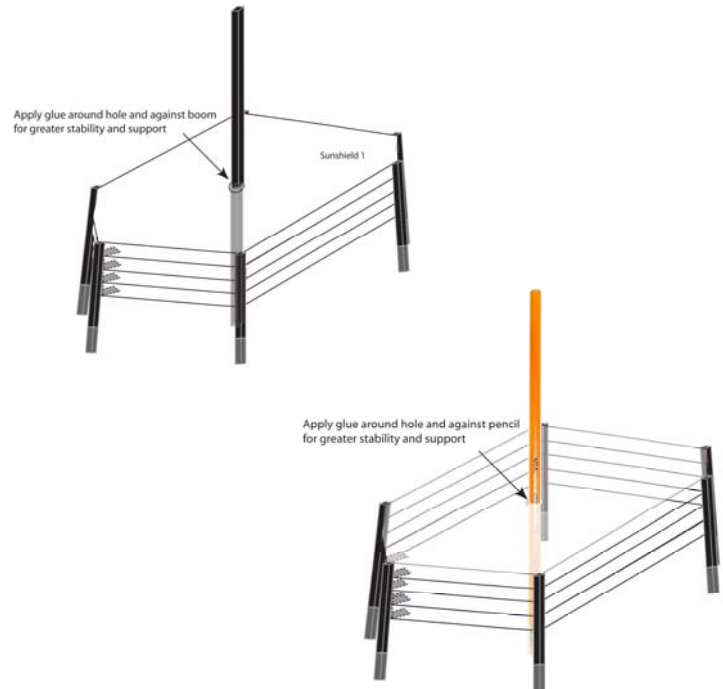
1. Trim on solid black lines
2. Score on dotted Lines
3. Fold lengthwise on each dotted line
4. Tuck 5th side in to form a box shape, let dry completely
5. Glue in place as shown on illustration
6. Note: Some trimming of beams may be necessary for an exact fit



Step 5: Attaching ISIM Instrument to Center Support Boom

5.1 ASSEMBLING AND INSERTING THE ISIM INSTRUMENT CENTER SUPPORT BOOM

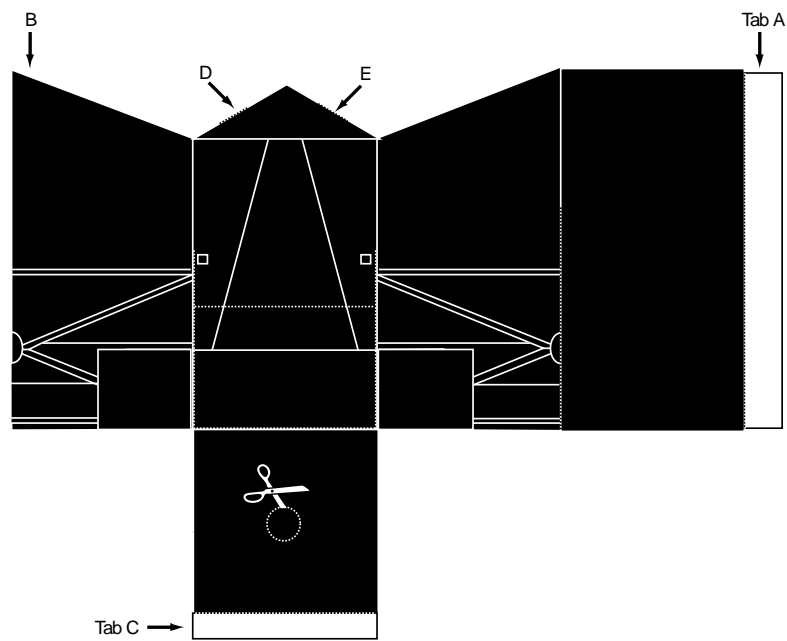
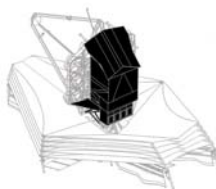
1. If not using a standard #2 pencil for the center support boom, trim along outside of black lines on card stock version of center boom
2. Score on dotted lines
3. Fold lengthwise on each dotted line
4. Tuck 5th side in to form a box shape
5. Run glue along inside of flap 5
6. Fold over small tab and press to close
7. Insert Center Support Boom down through the center hole Or use a standard #2 pencil for the Center Support Boom
8. Apply plenty of glue around the center circle and the Support Boom for greater stability



Step 6: Assembly of ISIM and EIC

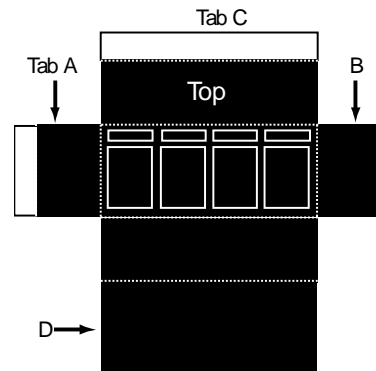
6.1 ISIM (INTEGRATED SCIENCE INSTRUMENT MODULE)

1. Score and fold along dotted lines to create a box shape
2. Cut out circle on Instrument bottom
3. Fold all white tabs inward to prepare for gluing
4. Glue tab A to the inside of panel B
5. Glue tab C to the inside of the box created from gluing tab A to the inside of panel B



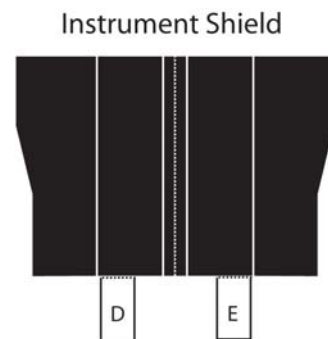
6.2 IEC (ISIM ELECTRONICS COMPARTMENT)

1. Cut out IEC along outside edges
2. Score and fold along dotted lines to create a box shape
3. Fold all white tabs inward to prepare for gluing
4. Glue tab A to the inside of panel B
5. Glue tab C to the inside of panel D
6. Glue top of IEC box to bottom of ISIM instrument



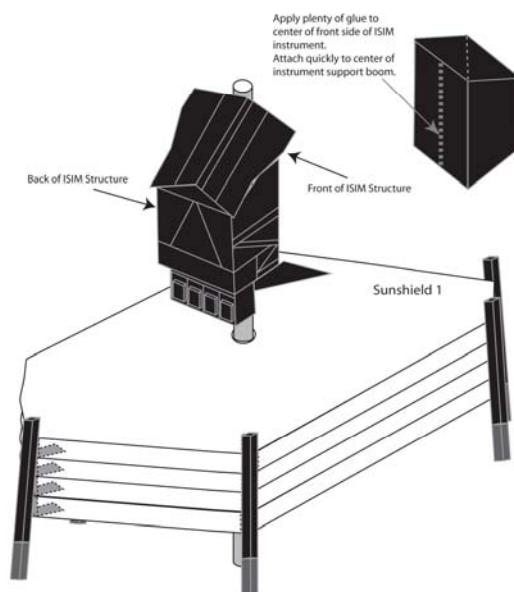
6.3 ISIM INSTRUMENT SHIELD

1. Cut out Instrument Shield along outside edges
2. Score along centerline and fold in half
3. Score and fold tabs
4. Center shield over the top of the ISIM instrument
5. Glue tabs D and E to the inside of ISIM instrument at dotted lines – D and E in Step 6.1



6.4 ATTACHING THE ISIM INSTRUMENT TO THE CENTER SUPPORT BOOM

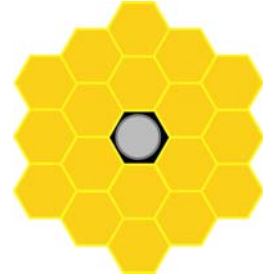
1. Apply plenty of glue to center of front side of ISIM instrument
2. Attach to center of instrument support boom – pencil or cardstock version
3. Hold in place for a few minutes to allow pieces to adhere to each other. If you are using a pencil, you can use a strip or two of clear tape for extra adherence and strength



Step 7: Assembly of Primary Mirror – Front and Back

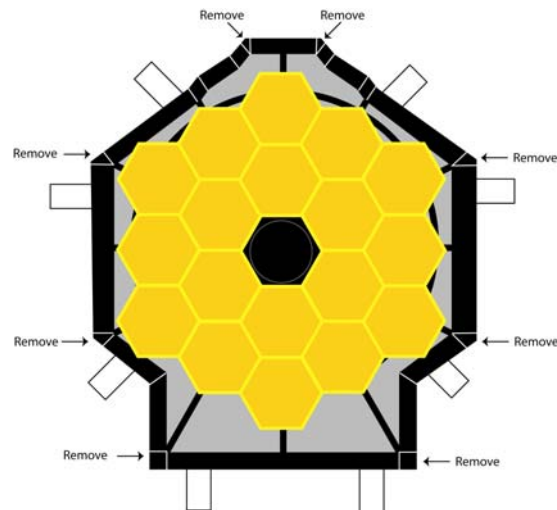
7.1 PRIMARY MIRROR

1. Trim out around edges
2. Glue Primary Mirrors on top of each other for a 3-D effect



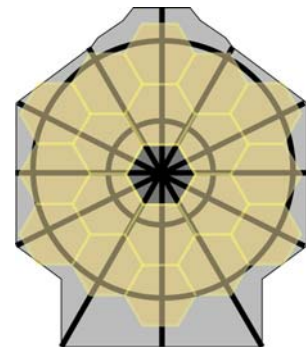
7.2 PRIMARY MIRROR BACKPLANE STRUCTURE – FRONT

1. Trim out Front Shield leaving tabs in place
2. Carefully cut on white lines and remove marked triangle and box shaped pieces
3. Score between thick black outline and grey interior shading
4. Fold the scores inward to create 90 degree edges
5. Fold tabs inward for gluing to Rear Shield



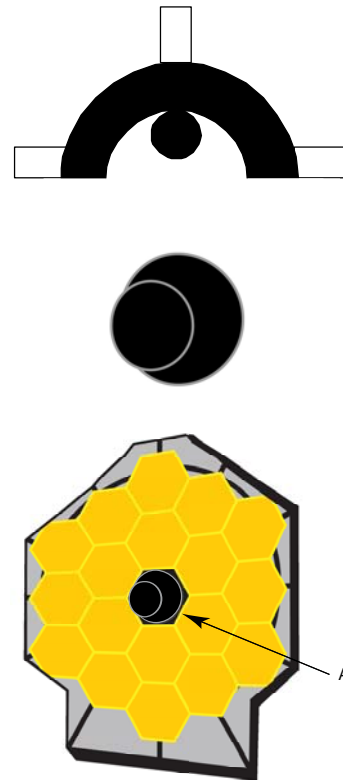
7.3 PRIMARY MIRROR BACKPLANE STRUCTURE – BACK

1. Trim out back of shield along black outline
2. Line up edges with edges of front shield (with tabs folded inward)
3. Glue to tabs
4. Apply glue to open edges and hold to close them
5. The shield should now be 3-dimensional



7.4 AFT OPTICS SYSTEM

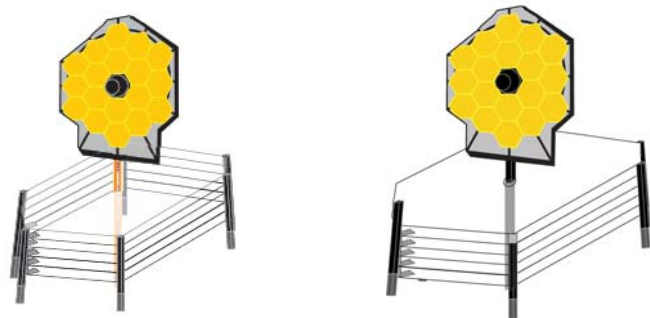
1. Trim out Aft Optics System
2. Fold tabs inward, away from the black side
3. Wrap half circle shape to form a cone, lining it up until the inside diameter matches the size of the center circle
4. Fold the center circle downward to close up the cone
5. Apply glue to seal cone together
6. Run glue along outer edge of circle and fold center circle down to close the cone
7. Fold white tabs inward and apply glue
8. Line up cone with the imprinted circle (A) on the primary mirror
9. Hold in place until adhered



Step 8: Attach Primary Mirror Assembly to Center Support Boom

8.1 ATTACH PRIMARY MIRROR ASSEMBLY TO CENTER SUPPORT BOOM

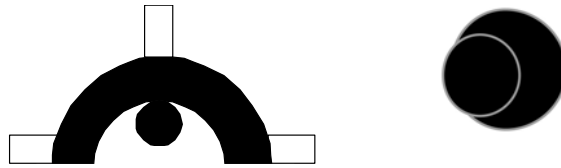
1. Apply plenty of glue to center instrument Center Support Boom. If you are using a pencil for Center Support Boom, apply glue to the pencil
2. Line up Mirror Assembly to the center of the boom and hold in place until adhered



Step 9: Assembly of Secondary Mirror with Support System Booms

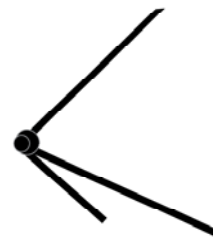
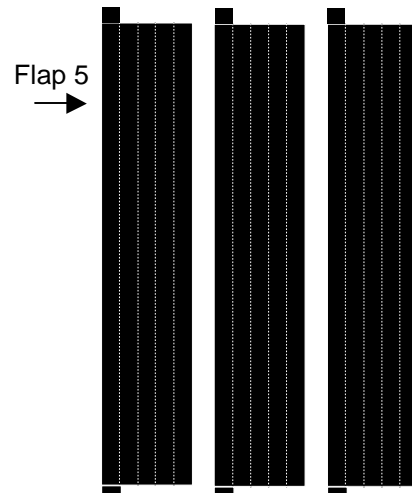
9.1 OTE SECONDARY MIRROR ASSEMBLY

1. Follow steps 1– 5 for Aft Optics System (Step 7.4)
2. Fold tabs inward and press firmly. This one will hold the OTE Secondary Mirror Support System Booms on the inside of the cone



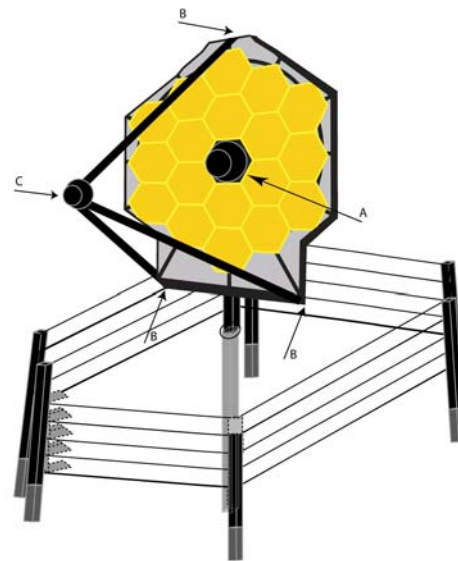
9.2 OTE SECONDARY MIRROR SUPPORT SYSTEM BOOMS

1. Trim out booms
2. Score along dotted lines lightly for folding
3. Fold along each score to form a box shape
4. Run glue along flap 5 and fold over to hold box shape boom in place
5. Repeat for remaining two booms
6. Booms will be attached in Step 9.3



9.3 ATTACHING THE AFT OPTICS SYSTEM AND SECONDARY MIRROR ASSEMBLY TO THE CENTER SUPPORT BOOM

1. Apply plenty of glue to folded inward flaps of aft optics system and attach to center of Primary Mirror Assembly, hold until firmly in place – A
2. Apply glue to open end caps of mirror support booms and attach in place as shown doing one at a time, hold in place – B
3. Apply plenty of glue to inside of Secondary Mirror Assembly and quickly insert free end of each Mirror Support Boom inside, shifting position until the unit is centered with the Aft Optics Mirror – C



Step 10: Photo of completed JWST Observatory Model

