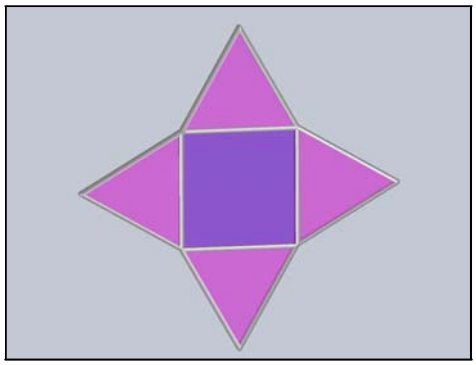
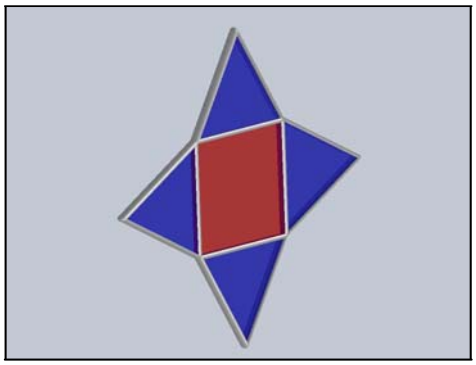
Stained Glass





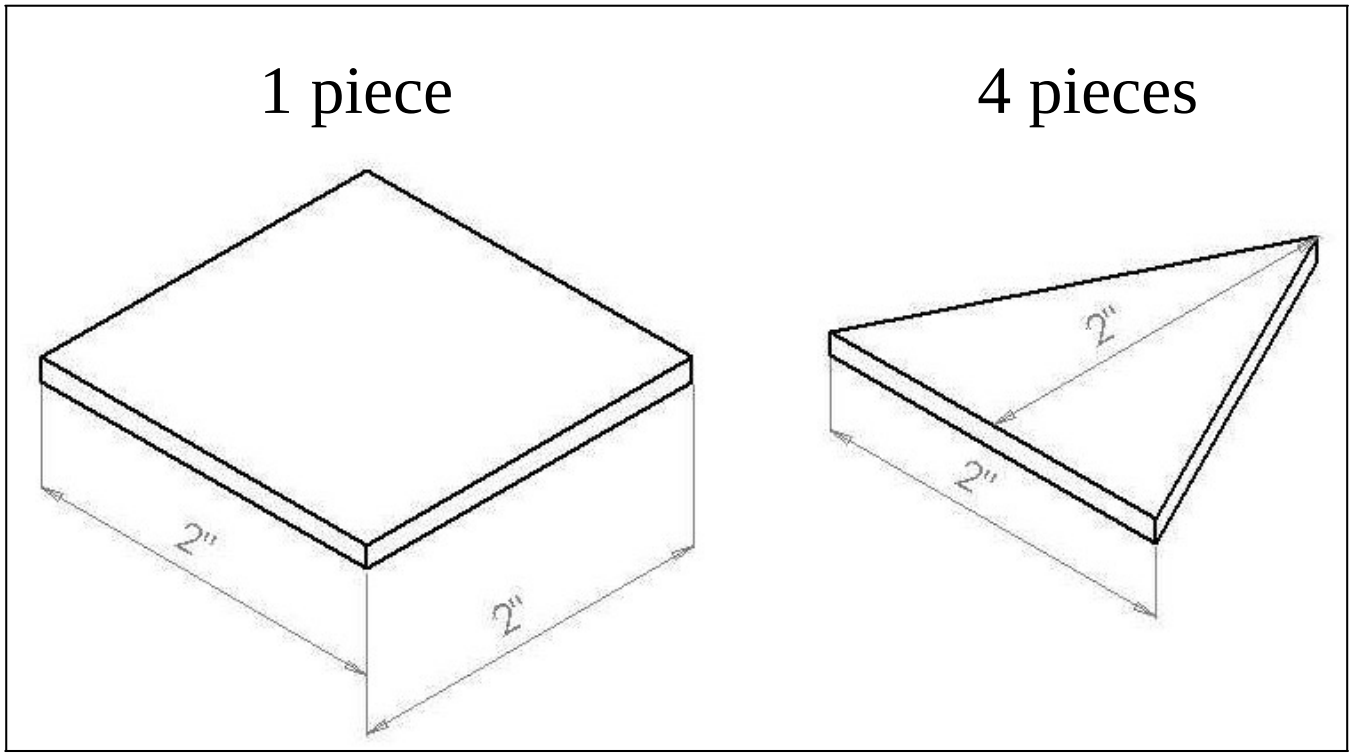
Equipment

A. Glass Cutter
B. Soldering Iron
C. T-pins
D. Straight Edge
E. Combination Square
F. Colored Markers
G. Brush
H. Safety Glasses
I. Rafter's Square

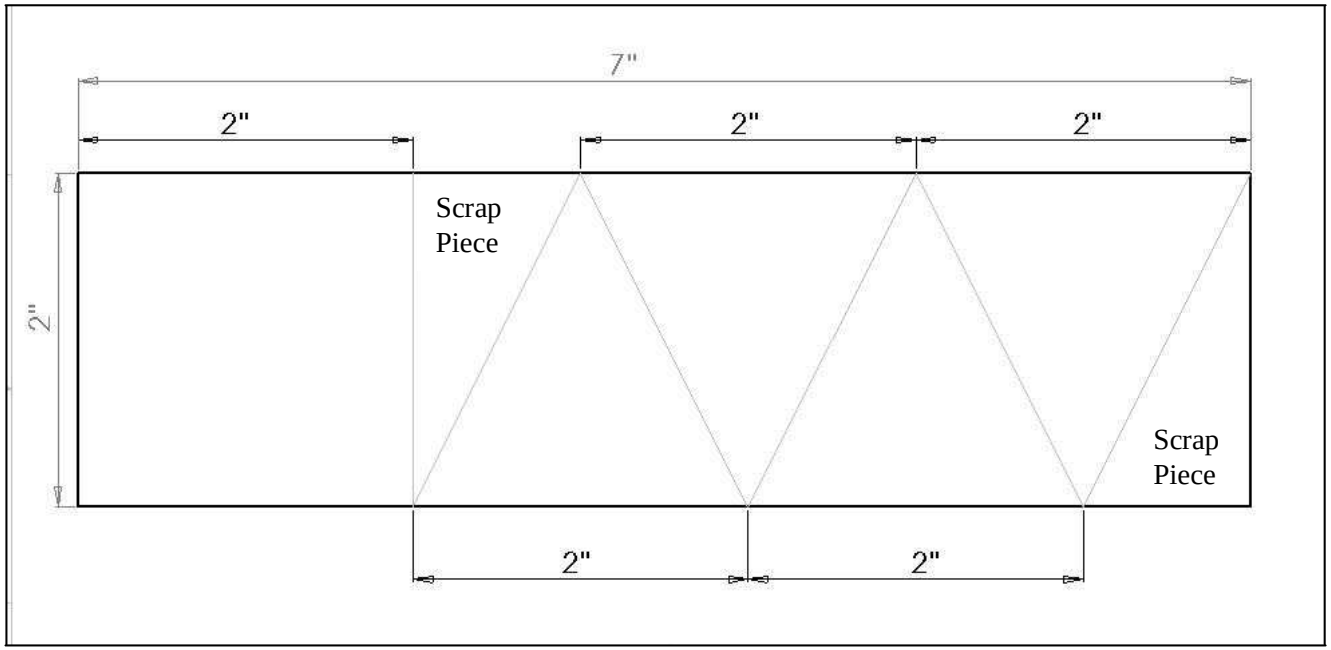
Materials

A. Glass
B. Cardboard
C. Flux
D. Copper Foil
E. Solder

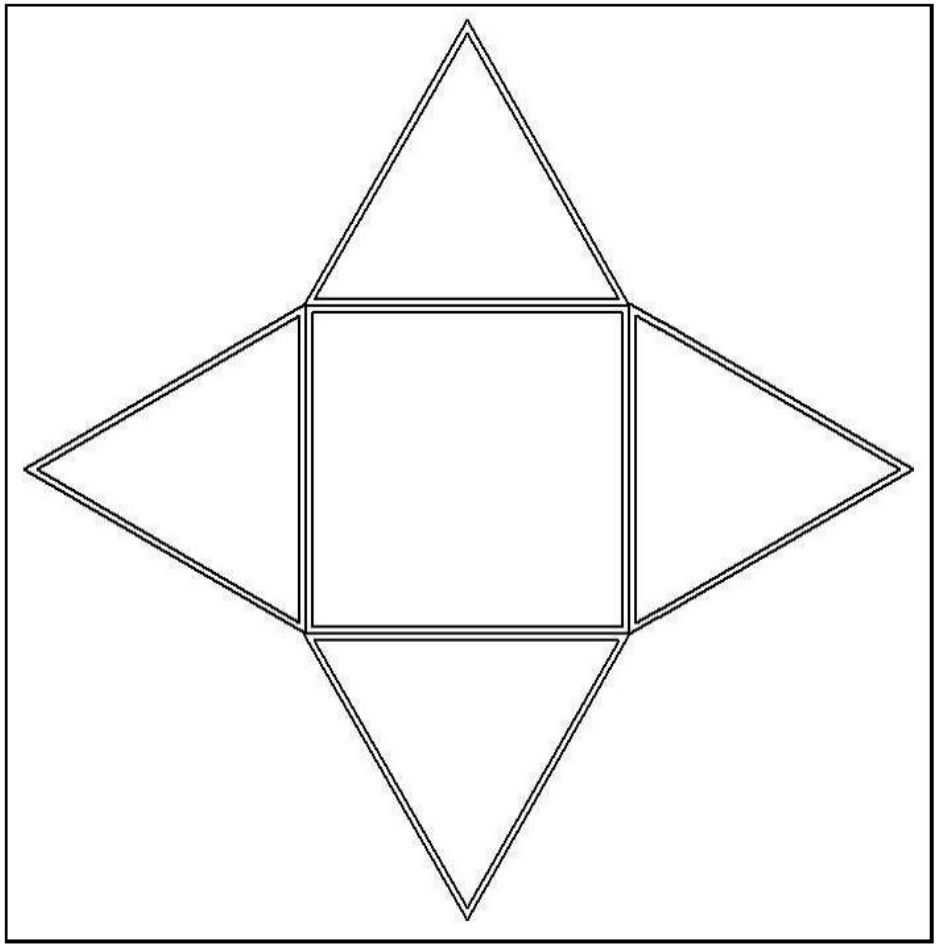
Drawing1: Complete Dimensions



Drawing2: 2”x7” Lay Out



Drawing 3: Final Assembly



SAFETY WARNING: This lab involves cutting glass. Improper scores/cuts can lead to sharp glass shards. Use caution at all times during this lab to avoid injury. Do not handle glass pieces with sharp edges and dispose of them properly.

Step 1: Lay out and cut a 2"x7" strip of **Glass** using a **Combination Square**, **Straight edge**, **Marker**, and a **Glass Cutter**.

Note: This project can be completed with a strip that is 7" long if the five pieces shown in **Drawing 2** (page 4) are cut out. This procedure outlines how to make the least scrap when cutting out these five pieces.

A. Using the **Combination Square**, mark a strip of glass that is 2" wide all the way across the sheet of glass which should be at least 7" long. For sheets of glass wider than the **Combination Square**, use a **Rafter's Square**. See Figure 1 for visual help with Step 1.

Note: When cutting glass, all cuts must be staight for the entire length of the glass.

B. Align the **Straight Edge/Square** with the line to guide the **Glass Cutter** as it is pushed across the glass. Use the **Glass Cutter** to score the line.

Note: When scoring glass, not a lot of pressure is needed. Press down just hard enough to hear a "zipping" noise as the cutter crosses the glass. All scores must go completely from one edge of the glass to the other. If the score stops before the edge of the glass, the glass will not break straight at that point. Cutting glass is more of an art than it is a science, practice is needed to get good results.

C. After the glass is scored, very gently tap the score with the ball end of the glass cutter. You should see the glasss start to crack underneath the score.

D. Align the score of the glass with the edge of the table as shown in Figure 1(3)While someone holds the glass down on the table, another person should gently push down the scored piece of glass while maintaining a firm grip. If it does not break off right away, stop and tap the score more.

E. Next, use the **Combination Square** to mark off a 7" section of the glass strip.

F. Repeat **A-D** to score and break the glass.

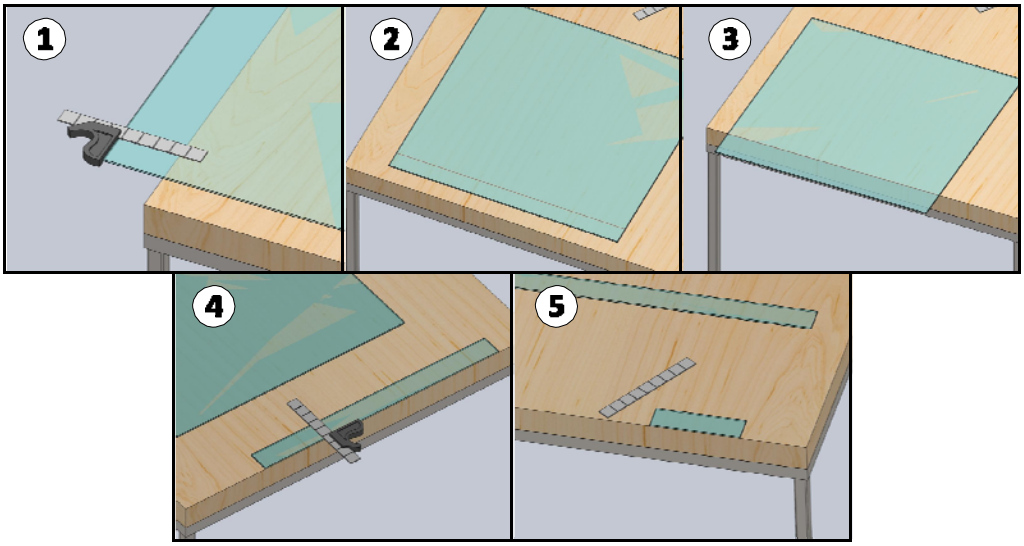


Figure 1: Cutting a glass strip- (1) Mark a 2" line across entire sheet of glass. If glass is longer than the combination square, use a rafter's square. (2) Piece marked and ready for scoring. (3) Align glass mark with edge of the table and gently apply downward pressure to break it off. (4) Mark off a 7" section. (5) Finished 2"x7" piece.

Step 2: Lay out the five pieces on the 2" x7" piece of glass using a **Straight Edge**, **Marker**, and the dimensions shown in **Drawing 2** (page 3) and Figure 2.

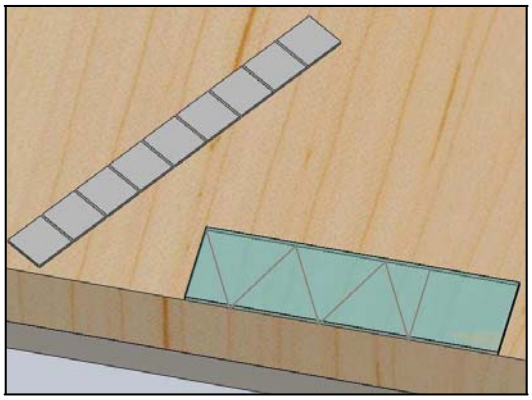


Figure 2: All five pieces drawn on glass piece

Step 3: Cut out all five pieces using a **Combination Square**, **Straight Edge**, and a **Glass Cutter**.

A. Follow the same procedure outlined in Step 1 to cut out all five pieces.

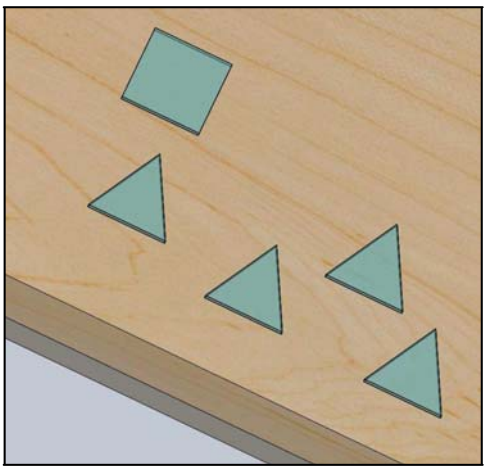


Figure 3: All five pieces cut out

Step 4: If clear glass is used, color the pieces using the **Colored Markers** any color you desire. Some examples are shown in Figure 4. All remaining figures demonstrate uncolored glass.

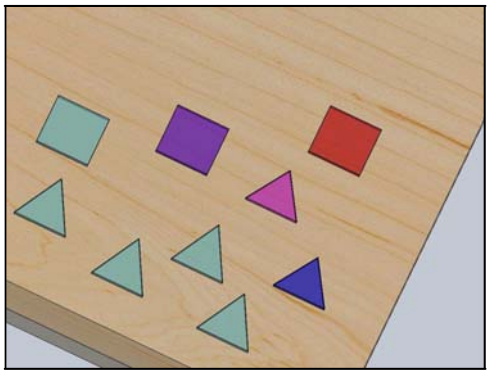


Figure 4: Colored pieces

Step 5: Wrap each piece edge in **Copper Foil** using **Scissors**.

A. The **Copper Foil** has an adhesive backing that will help it stick to the edges of the glass as you wrap it around each piece.

B. Remove the backing from a small piece of the foil and stick it to the edge of one of the glass pieces as shown in Figure 5 (1). Keep removing the backing as you stick the foil to the glass. Center the foil on the edge of the glass as shown in Figure 5 (2) so when it is completely foiled, the two edges of foil can be folded on the glass. When you get close to completely covering each edge with foil use the **Scissors** to cut the foil from the spool. Make sure you do not cut the foil too short!

C. Next, fold the edges of the **Copper Foil** down onto the glass with your fingers. Once each side is folded down, use a non-cutting side of the **Scissors** to flatten out any wrinkles in the piece as shown in Figure 5 (4). Do not press too hard, or you may tear the foil.

D. Repeat this process until all five pieces are foiled.

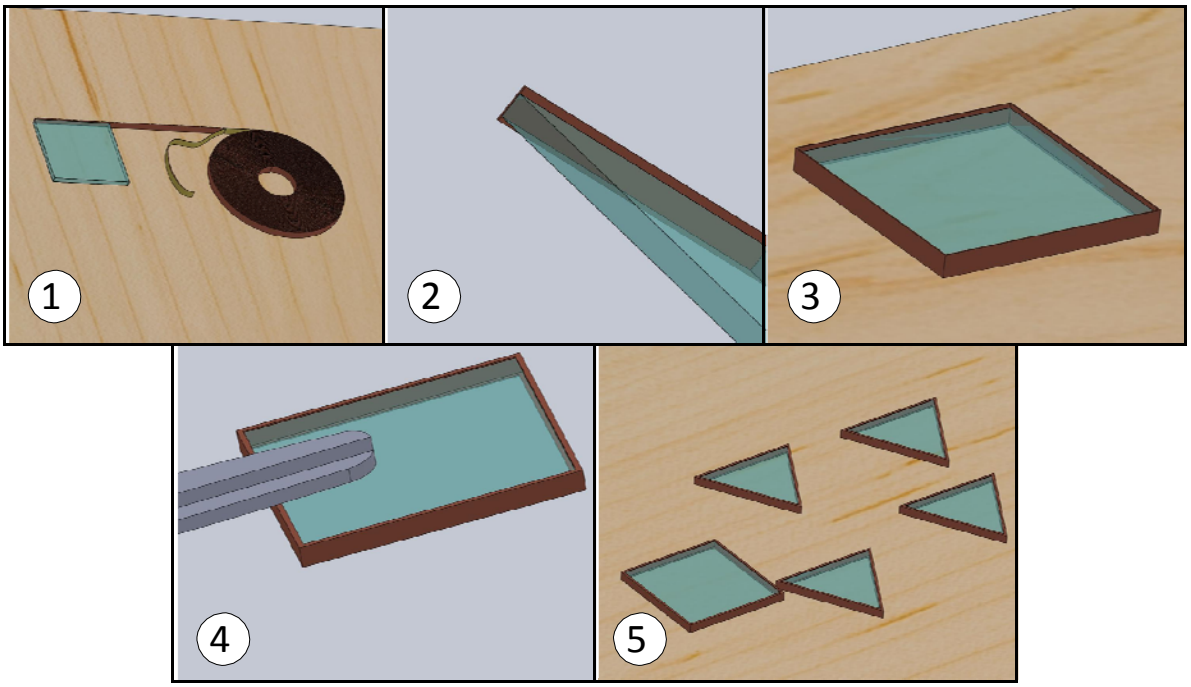


Figure 5: Foiling the pieces- (1) Remove a little of the foil backing and start foiling at one corner of the glass piece. (2) Center the foil on the glass edge. (3) Make the foil go all around the piece and end where you started. (4) Use a scissors to flatten the wrinkles in the foil folds (5) Finish all five pieces.

Step 6: Assemble the pieces as shown in **Drawing 3**(page 5) using **Cardboard**, and **T-pins**.

Note: To save time, plug in the **Soldering Iron** now so that it is ready to use in Step 7. Be sure the tip is not touching anything while it is warming up. Do not leave it unattended.

A. Place each piece in the correct orientation to make a star shape on top of the **Cardboard**.

B. With each piece in place, stick **T-pins** into the cardboard in the locations shown in Figure 6. Make sure the pins are snug up against each piece and each piece is snug with each other. The pressure from the pins holds the pieces in the correct orientation while they are being soldered.

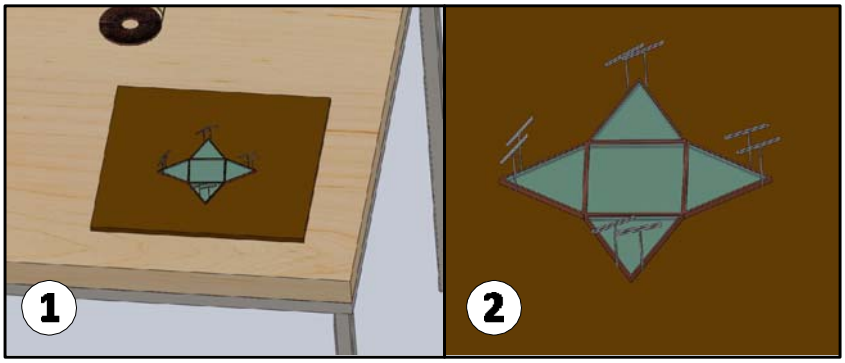


Figure 6: Pinning the pieces in place- (1) Lay out the piece and tack it together. (2) Make sure you position the tacks so they hold the pieces snug together.

Step 7: Apply **Flux** to every foil seam on the assembly that is showing and then solder all showing seams using a **Brush**, **Solder**, **Safety Glasses**, and a **Soldering Iron**.

Note: Apply flux sparingly, apply enough to cover the entire seam without globbing. Flux is used to remove any oxides from the copper foil and makes the solder and copper more able to dissolve into each other.

SAFETY WARNING: The soldering iron will be hot!! Do not touch it to your skin or clothing.

A. After flux is applied, tack each seam at both ends with a small drop of solder as shown in Figure 7 (1). To do this, touch the tip of the soldering iron to the copper foil for a couple of seconds to allow it to heat up. If the foil is not hot when you apply the solder, the two metals will not fuse resulting in a weak joint. If you leave the hot iron in the same place for too long, the glass could crack. Once the foil is hot, touch the solder to the soldering iron tip and foil. After a small blob of solder melts into the seam, move to the next location, Figure 7 (2).

B. When every seam is tacked with solder, make a bead of solder along the entire seam using the same method as tacking but continuously moving the soldering iron and solder along the seam as the solder melts as shown in Figure 7 (3). You should go slow enough to leave a nicely domed bubble of solder all along the seam. If the seam looks uneven, apply more solder or simply run the soldering iron over the seam, re-melting the solder into a nice bead.

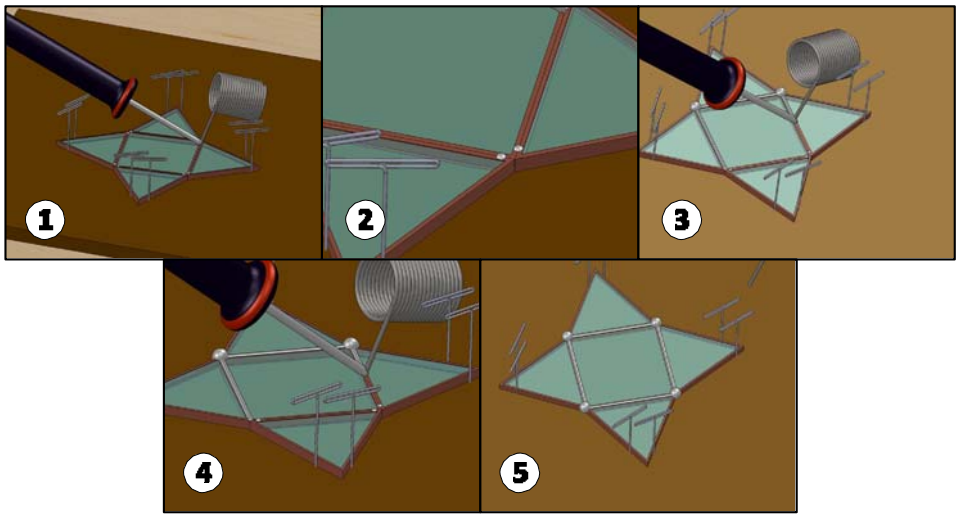


Figure 7: Tacking and soldering- (1) Warm a corner and apply a small tack of solder. (2) Tack all seams on each end of the seam. (3) After all tacks are made, start soldering the entire seam. (4) Make sure to apply heat to the foil before applying solder. (5) All four seams soldered on the first side.

Step 8: Unpin the assembly and tin the edges of the assembly using a **Brush**, **Flux**, **Soldering Iron**, and any solder that has collected on the edges.

A. Apply flux to all edges of the assembly and then run the iron up and down the vertical edges, smearing the excess solder over the foil edges allowing any extra to drip off as shown in Figure 8. This is called "tinning the edges". Do not worry if it does not cover the all the edges, more solder will accumulate on the edges when the next side is soldered.

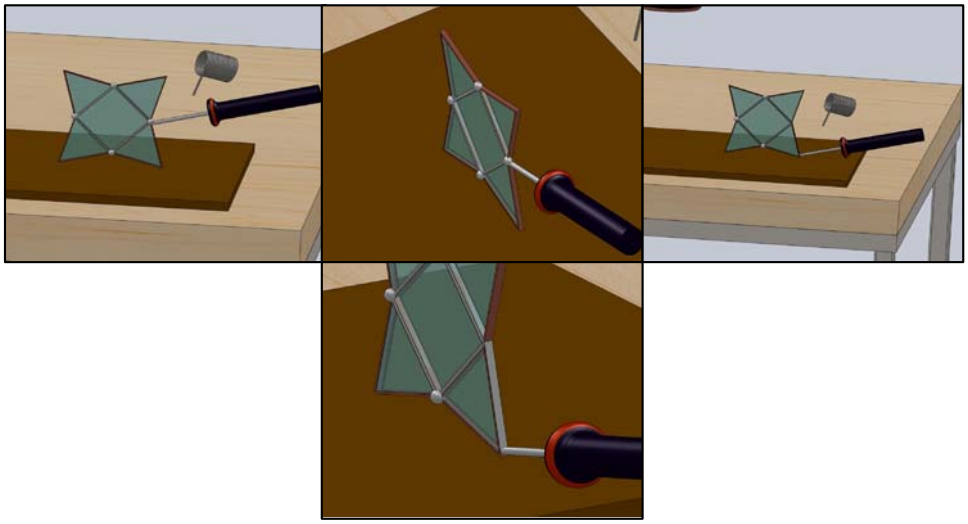


Figure 8: Use the soldering iron to guide the extra globs of solder to the edges of the piece for tinning

Step 9: Flip the assembly over and solder all remaining seams. Tin the rest of the edges.

A. Use the same process outlined in Step 7 to solder the remaining seams. Run each bead a little bit faster than the first side. If the seams get too hot, the previously soldered seams on the opposite side can heat up and re-melt.

B. After all seams are soldered, tin the edges again to remove all excess solder. If not all edges are covered after all excess solder is used up, apply small amounts of solder to the desired locations and continue to tin.

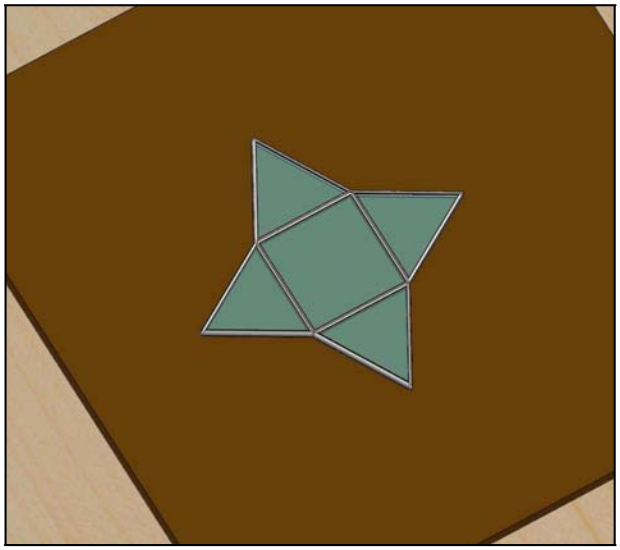


Figure 9: Finished piece

Step 10: Wash all flux off the assembly with slightly warm, soapy water.

Note: Do not use cold water. If cold water is used, thermal shock may occur with the glass, causing it to crack.