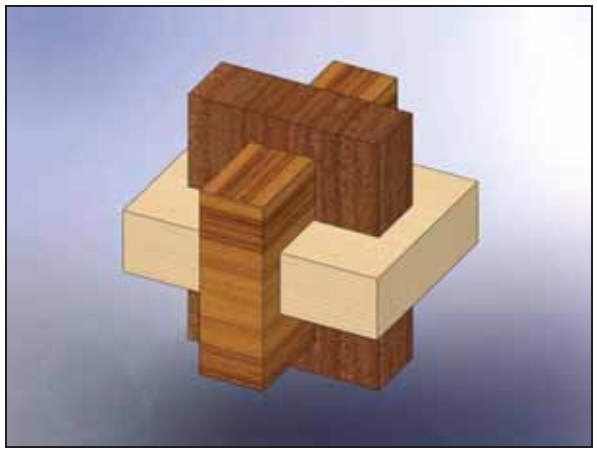
Wood Puzzle



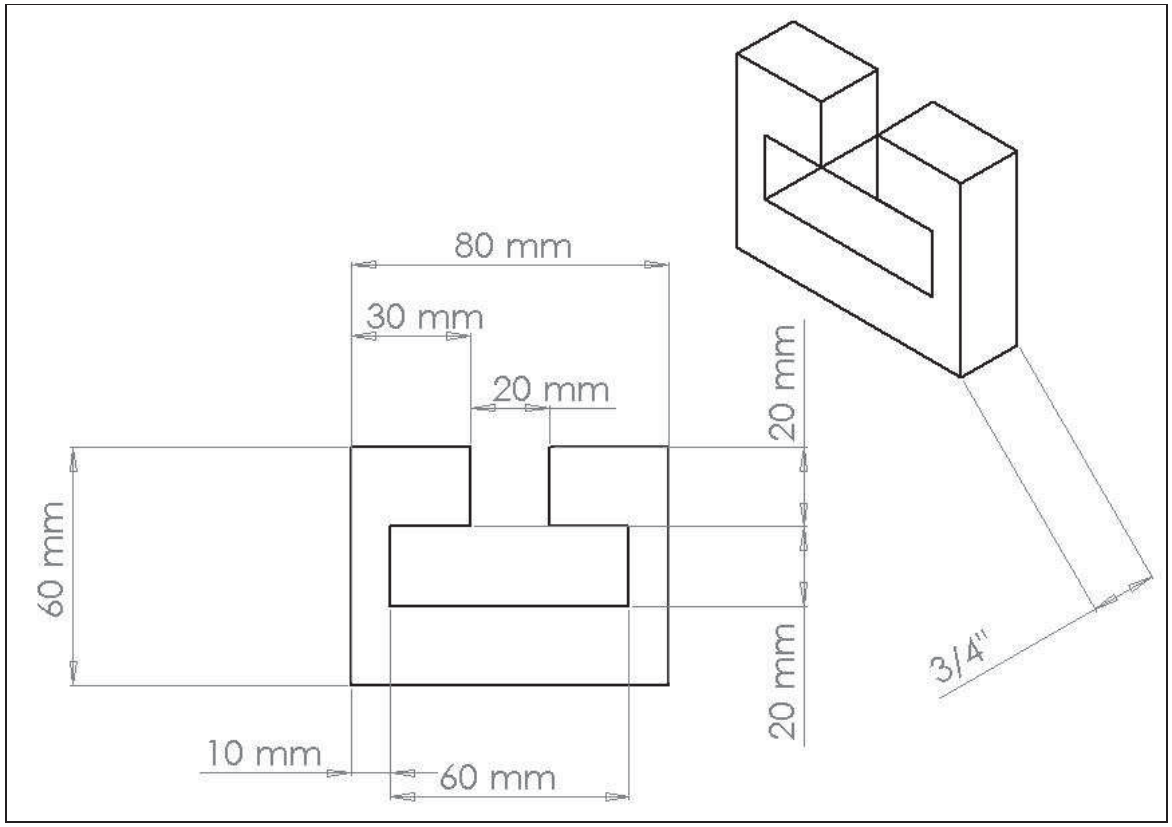
Equipment

A. Band Saw
B. Straight Edge
C. Combination Square
D. Miter Saw
E. Pencil
F. Safety Glasses
G. Two Bar Clamps
H. 3/4” Spade Bit

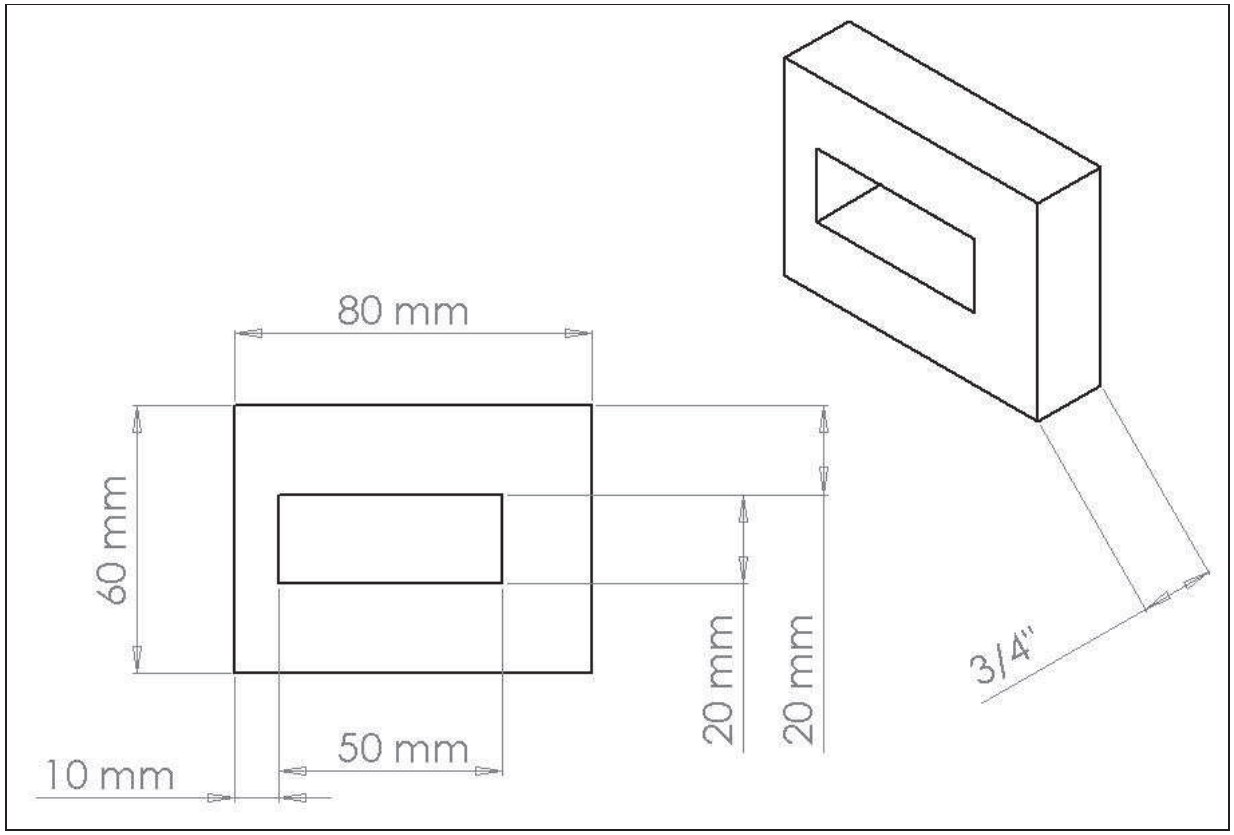
Materials

A. 1” x 4” x 8” Lumber
B. Sand Paper
   a. 80, 120, 180 grit
C. Rubbing Oil
D. Cheese Cloth
E. Scrap Wood
F. Scrap Paper

Drawing 1: Complete Dimensions for Piece 1



Drawing 2: Complete Dimensions for Piece 2



Step 1: Lay out and cut two 100 mm long sections from 1" x 4" lumber stock using a **Combination Square**, **Pencil**, and a **Miter Saw**.

Note: Using the **Combination Square** ensures a rectangle with sides that are perpendicular to each other.

Pitfall prevention: It is important not to mark both pieces before cutting. Due to the width of the saw blade, if both lines are marked at once, the first cut will throw off the second mark by the width of the blade.

A. Use the **Combination Square**, and a **Pencil** to mark out a 100 mm section on the lumber stock as show in Figure 1.

Note: The pieces shown in **Drawings 1** and **2** are only 80 mm long, yet the procedure calls for the sections to be cut 100 mm long. This is done to pare down the rough lumber into smaller sections that are easier to work with on the band saw.

B. Cut the 100 mm sections using the **Miter Saw.**

C. Place the board on the **Miter Saw table** so the 100 mm mark is close to the blade. Place a shim that is the same height as the miter saw table underneath the end of the board farthest away from the saw as shown in Figure 2**.**

Note: Putting a shim under this side of the board will allow the saw to make a 90º cut with the top of the board.

D. Next position the board so the 100 mm section is to the right of the saw blade. Then position the line directly to the right of the blade as shown in Figure 3. If the line is positioned directly under the blade, the 100 mm board will be half a blade's width short of 100 mm. Clamp the board snug against the back of the **Miter Saw**. This can be done with the clamp on the saw.

E. With all objects away from the blade and **Safety Glasses** on, turn on the saw and slowly lower it into the wood

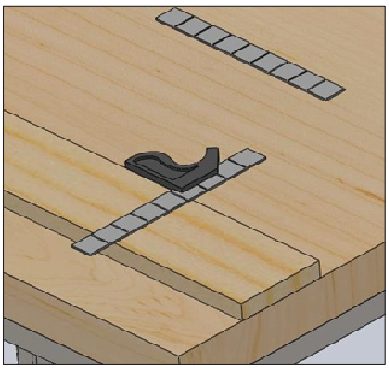


Figure 1: **Laying out 100mm piece**

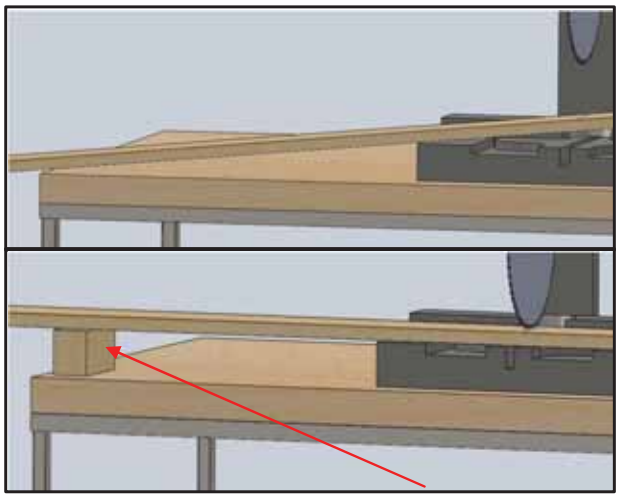


Figure 2: **Propping up the board with a shim**

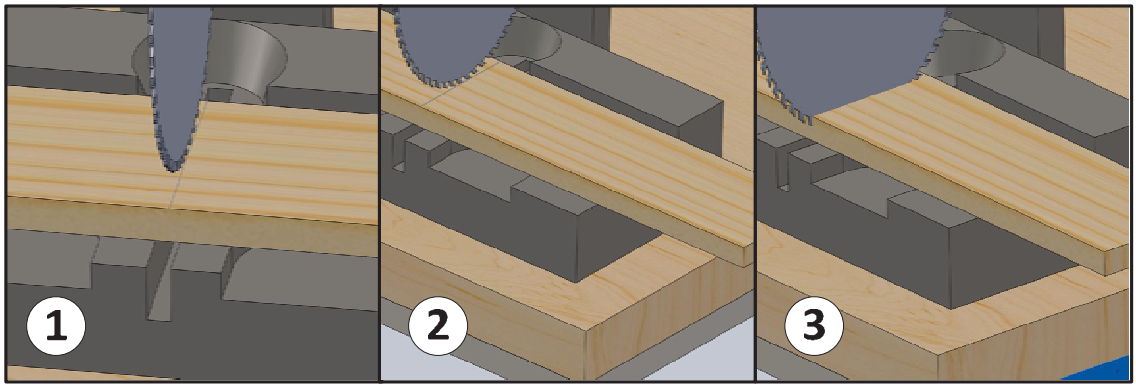


Figure 3: **Cutting the piece**- (1-2) Align blade to the side of the line opposite of the desired piece. (3) While the saw is on, slowly enter the blade into the wood and complete the cut.

Step 2: Layout two of **Piece 1** using the **Combination Square**, **Straight Edge**, **Pencil**, and the dimensions found in **Drawing 1: Complete Dimensions Piece 1** (page 3) on the two pieces cut in Step 1.

A. Draw all of the edges of the piece on a 100 mm section. The width of the **Piece 1** is already the size of the lumber.

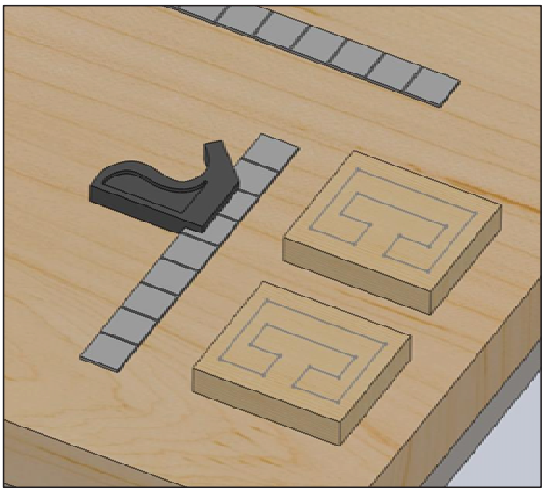


Figure 4: **Two pieces with layout of piece one**

Step 3: Cut out both Step 2 layouts using the **Bandsaw**.

A. Put **Safety Glasses** on everyone in the group.

B. Remove all objects from the table of the Band Saw.

SAFETY WARNING: Before starting the saw, make sure ALL objects AND the work pieces are removed from the table of the band saw. Objects, including the 100 mm sections can become pinched between the blade and the table and thrown from the machine, possibly hurting others nearby.

C. Turn on the **Band Saw**.

D. Place the 100 mm section on the table of the **Band Saw**.

Note: When making a cut with a band saw, the blade should be offset to the side opposite the desired piece. Due to the width of the saw blade, if you cut down the center of the drawn line, your piece will be half the blade's width smaller than what you measured.

SAFETY WARNING: Keep your fingers as far away from the blade as possible while mantaining a firm grasp of the 100 mm section.

E. Slowly bring the 100 mm section into contact with the blade of the Band Saw

A. Slowly feed the 100 mm section into blade until line is fully cut. See Figure 5.
B. First cut out the inside lines. When cutting the inside of the piece, make smaller sub cuts until the correct lines are cut as shown started in Figure 6.
C. Next, cut the outside lines.

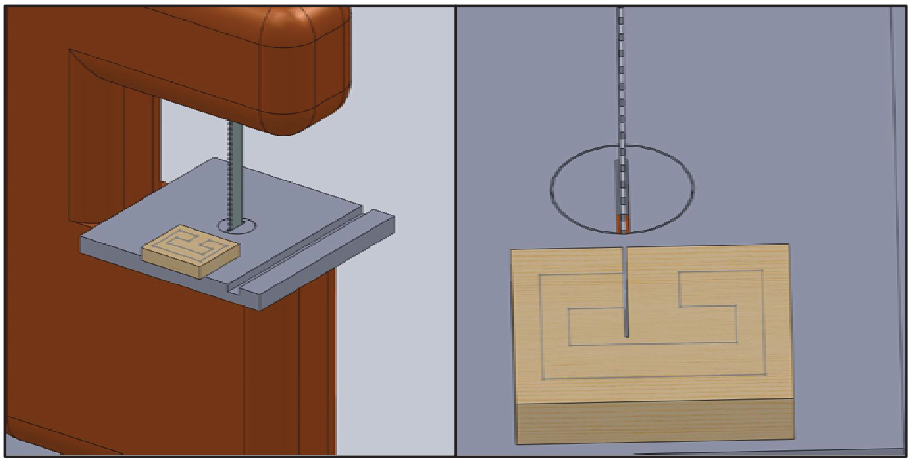


Figure 5: Cut the inside lines first. Make sure to cut on the scrap wood side of the line

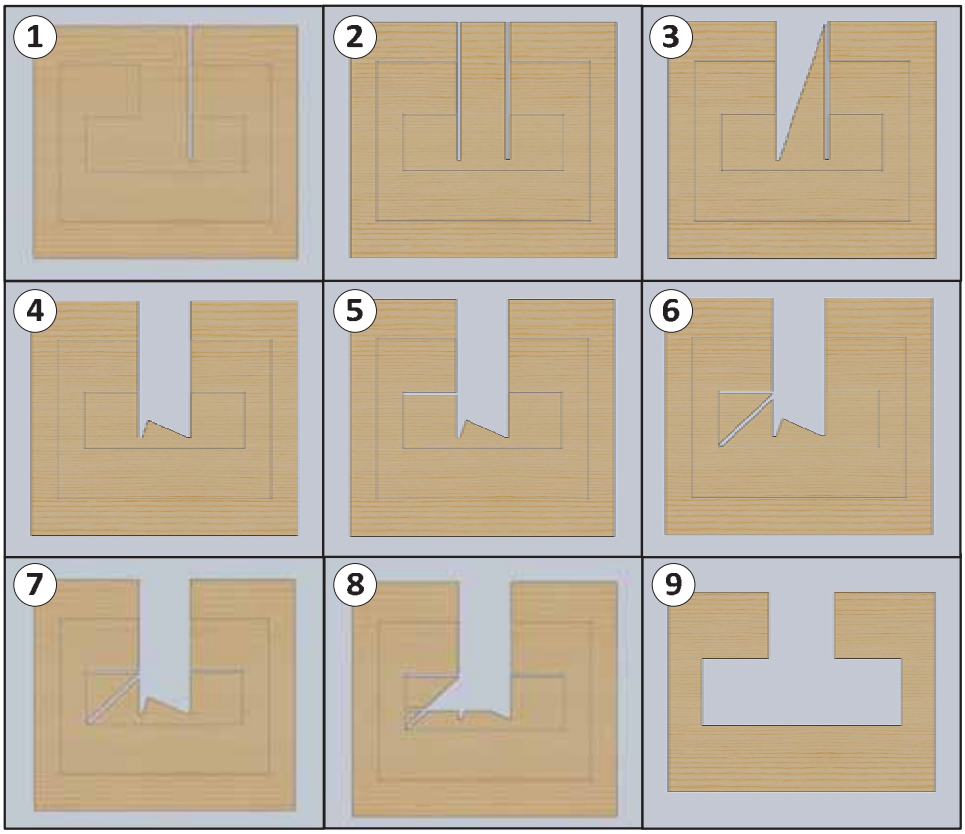


Figure 6: Example of sub cut order. Make sub cuts to clear all inside scrap.

Step 4: Lay out one 100 mm long section from 1" x 4" lumber stock using a **Combination Square**, and a **Pencil**

Note: Do not cut the 100 mm section apart from the rest of the 1" x 4" lumber stock.

Step 5: Lay out **Piece 2** using the **Combination Square**, **Straight Edge**, **Pencil**, and the dimensions found in **Drawing 2: Complete Dimensions Piece 2** (page 4) on the 100 mm section layed out on the 1" x 4" lumber Stock as shown in Figure 7.

Step 6: Locate and mark the center of the inside cutout of **Piece 2** with the **Straight Edge**, and a **Pencil** as shown in Figure 7.

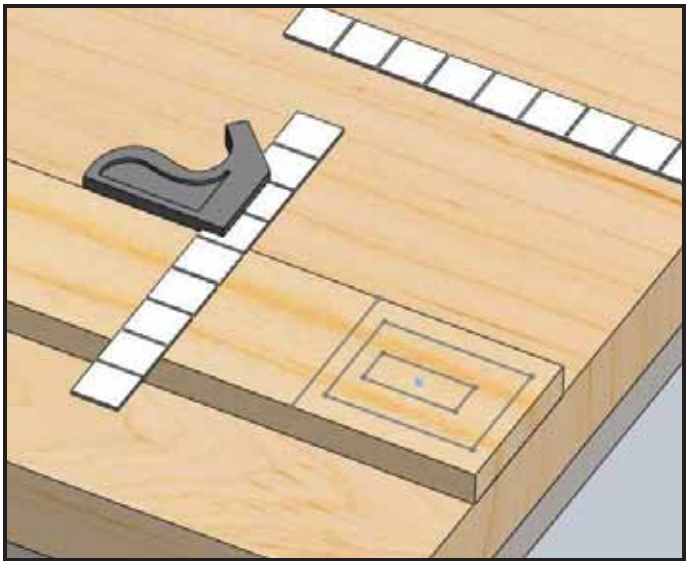


Figure 7: Layout of Piece 2 on the stock lumber. Mark the center of the inside square

Step 7: Using a **3/4" Spade Bit**, bore a hole though the center of the **Piece 1** layout as marked in Step 6 using a **Bar Clamp**, **Scrap Wood**, and the **Drill Press**.

A. Clamp the layout on top of a piece of **Scrap Wood** that is at least 1" thick to the **Dril Press** as shown in Figure 8.

Note: A piece of scrap wood is placed underneath the lay out because the **Spade Bit** is wider than the hole in the drill press table. If the scrap wood is not present during the drilling procedure, the spade bit will run into the table before the hole is completely drilled, ruining the bit and drill press table.

B. With the bit aligned with the center mark drawn in Step 6 and safety glasses on, start the drill press and slowly push the drill bit through the wood until the hole is completely through the top piece of wood as shown in Figure 8.

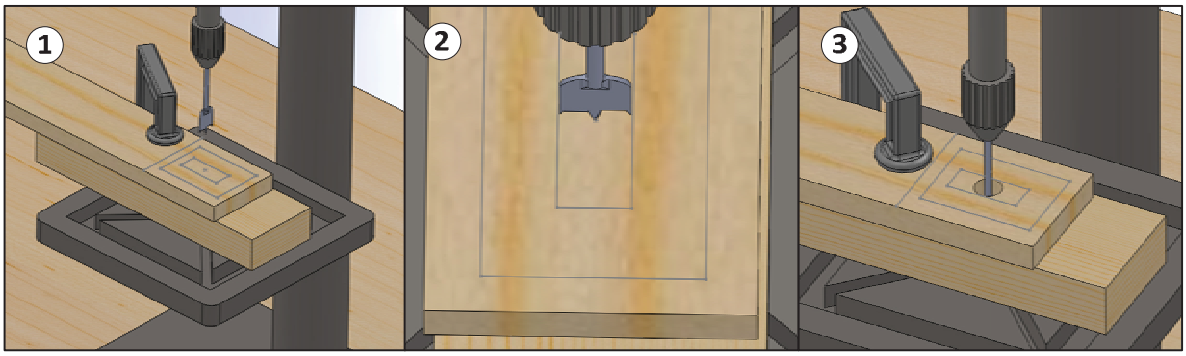


Figure 8: Drilling the center hole- (1) Clamp stock lumber onto drill press with 1" scrap beneath. (2) Align up the spade bit with the center mark. (3) Slowly enter the spade bit into the wood, making sure not to go deeper than the scrap to prevent running into the drill press table.

Step 8: Cut out the inside pocket of **Piece 2** using two **Bar Clamps**, and a **Jig Saw**.

A. Position the sketch of **Piece 2** over the edge of the table and clamp the wood snug with two **Bar Clamps** as shown in Figure 9.

B. Using a **Jig Saw**, cut the inside pocket out as shown in Figure 9.

Note: To get the feel of the jig saw, it may be helpful to clamp a scrap piece of wood to the table and practice cutting with the jig saw before cutting **Piece 2** out.

Note: This cut would ideally be done with a scroll saw. To get proficient at fabrication, one must learn to improvise with what is available. On that note, improvise with safety and caution.

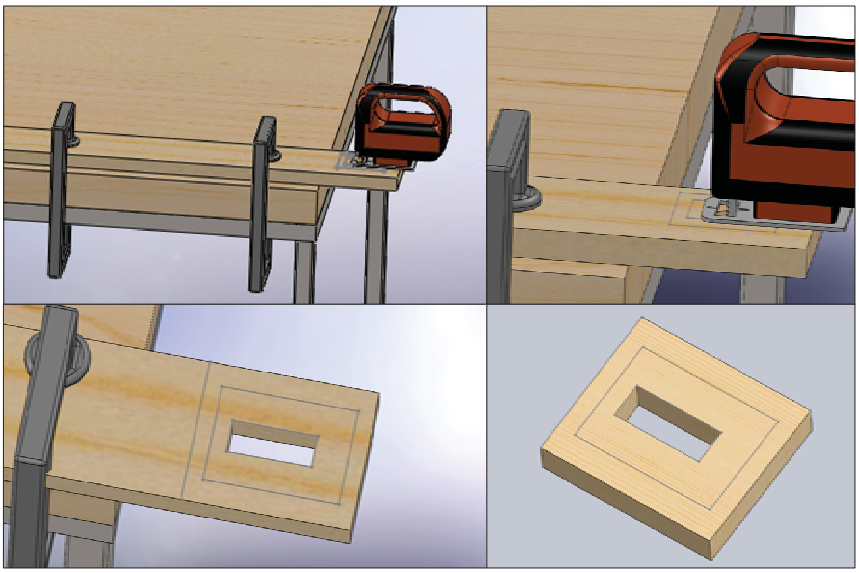


Figure 9: Clamp the stock lumber to the table with two 12" bar clamps with the layout hanging over the edge. Use the jig saw to cut out the center of the block. Be careful and take your time. Use several cuts to clear all of the scrap.

Step 9: Cut 100 mm section of **Piece 2** from the 1" x 4" stock lumber using the **Miter Saw**, using the procedure outlined in Step 1.

Step 10: Finish cutting out **Piece 2** using the **Band Saw**, and the procedure outlined in Step 3.

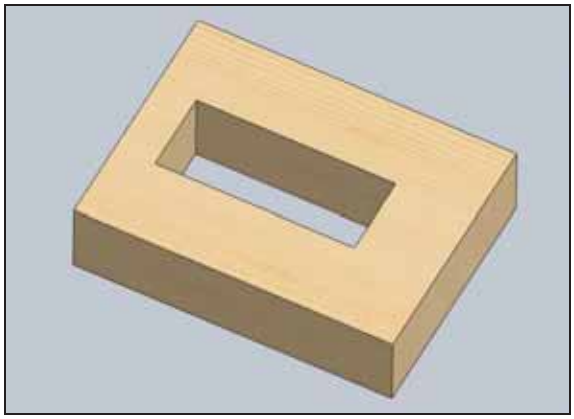


Figure 10: Finished Piece 2

Step 11: Hand sand each of the three pieces with 80, 120, and 180 grit sandpaper to remove any blade marks and rough edges

Note: Sandpaper is measured by the size of the abrading particles bonded to the paper. Big grit numbers are fine sandpapers that have small particle sizes and small grit numbers are course sandpapers that have big particles. The finer the sandpaper, the smoother the finish it will leave.

A. When sanding wood, always sand with the grain. Start with course grit sandpaper to sand out all the deep scratches and cut marks. After all the major scratches are out and the wood is not becoming any smoother, switch to the next size grit sand paper and repeat the process. Finally, use the 180 grit sand paper until the wood has not apparent change in texture.

B. Try fitting the pieces together as shown if Figure 12. If they do not fit together, figure out what is binding and either sand or saw the pieces until they properly fit together.

Step 12: Finish the puzzle pieces by adding **Rubbing Oil** to stain the wood using a **Cheese Cloth.**

Note: Rubbing oil can be applied to as many of the pieces as the team wants as shown in Figure 11. At least one piece must be stained.

A. Cover the the work area with scrap paper so the rubbing oil does not stain the work area.

B. Follow the directions on the **Rubbing Oil** very carefully and apply it to the puzzle pieces using **Cheese Cloth**. Becareful not to spill the rubbing oil on your clothes or table as it will stain. Dispose of **Cheese Cloth** as directed on **Rubbing Oil** container.

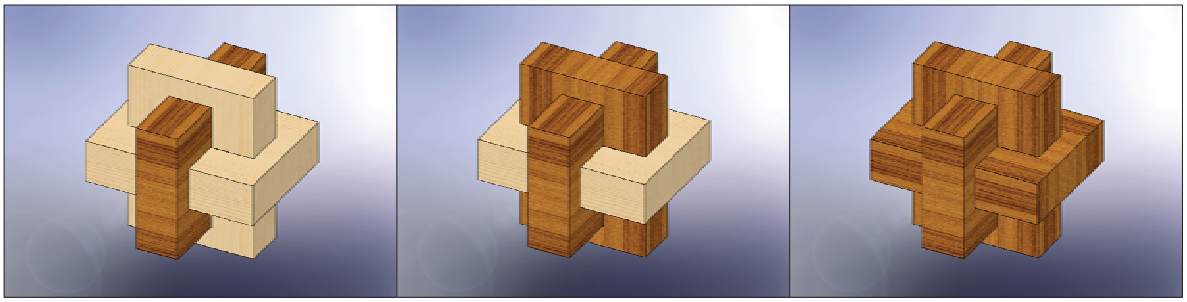


Figure 11: Variations on how many of the pieces are stained

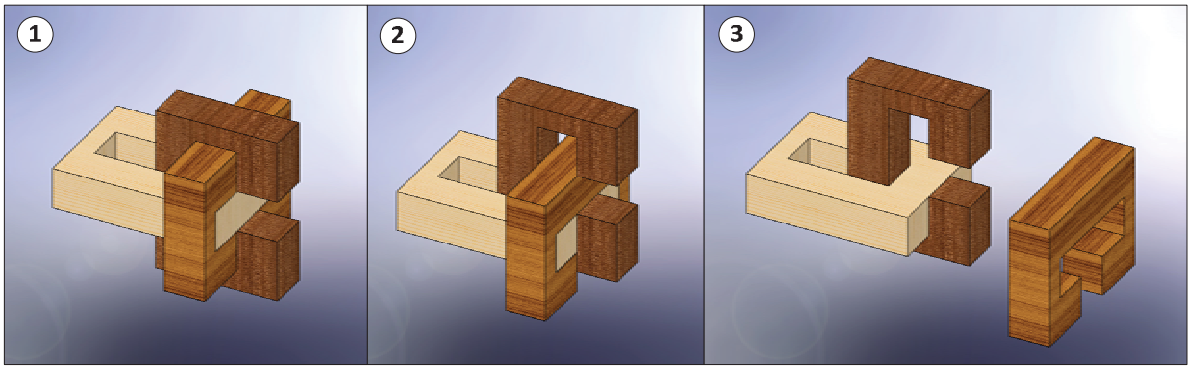


Figure 12: Assembly/disassembly of puzzle directions