

Activity 4.5 – Pegboard Toy



Purpose

When you receive a toy, what is the first thing you wonder about it? Do you wonder how it works? Sometimes when you received or bought a toy, did you ever wonder who designed it or who may have made decisions about its color or the materials that were used to make it? Being a toy designer would seem like it might be easy, or would it?

Designing a toy can be a challenging but fun process. You must consider many factors, such as safety, materials, and appropriate use. In addition, you have a chance to try out ideas and experiment with what you think might be fun to play with; however, you must design something that is useful and will be liked by kids like yourself.

Learning how to design is also a process that takes time and different opportunities to explore and learn. In previous lessons and activities, you have been taught different aspects about design, sketching, and 3D modeling. In this activity, you will see how a pegboard with matching mallet is designed and the pieces tested to see that they fit appropriately and that they are easy for a young child to enjoy playing.

Equipment

Computer with appropriate software, such as Inventor

Sample pegboard with mallet in **Figure 1**.

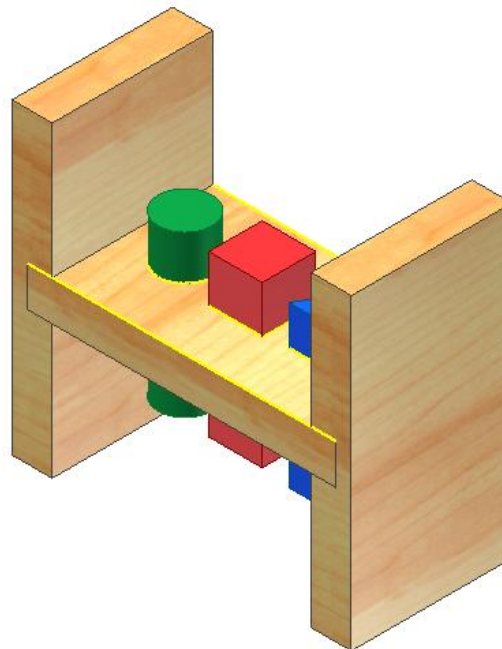


Figure 1

REVISED 01-15-2016

MR. SHRILLA'S PEGBOARD TOY PROJECT

Procedure

As a new employee of Tattered Toy Company, you were asked to learn more about their best selling toy, the Pegboard (See Figure 1). Your supervisor, Mr. Duggle stated that you would need to know how the pegboard was designed. He wants you to learn as much about the design process as possible while working on this project.

“You will need to keep track of your work, so be sure you keep notes and check off your work as you complete each step,” continues Mr. Duggle, “I will be checking your work and watching how you work with others.”

You reach for your engineer’s notebook, sketch paper, and pencil to prepare to keep notes. You want to learn how to make a 3D model of the Pegboard. As Mr. Duggle leaves you to work he calls back to you, “Good luck! Be sure to save all of your work so we can review it later.”

Directions

Read each step, perform each operation, and check them off after completion.

Creating Parts:

1. **Open a new Part File.**
2. Create a round part 1” diameter and is Extruded 3” long.
3. Change the ***As Material*** to whatever you would like.
4. Save as **ROUND PEG** (.ipt) in this path:
My Documents→Inventor→Inventor Projects→Project 2
See Figure 2.

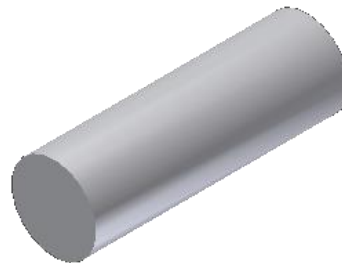


Figure 2: Round Peg

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1. Open a new **Part File**.
2. Create a square part 1" x 1" and is Extruded 3" long.
3. Change the **As Material** to whatever you would like.
4. Save as **SQUARE PEG** (.ipt) in this path:
My Documents→**Inventor**→**Inventor Projects**→**Project 2**
See **Figure 3**.



Standard.ipt

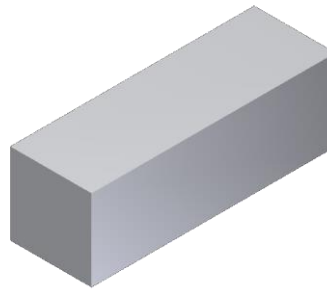


Figure 3: Square Peg

5. Open a new **Part File**.
6. Create a 1" **equilateral triangle**, extruded 3" long. Hint: Use the Polygon tool, then set any side to a dimension of 1".
7. Change the **As Material** to whatever solid color you like.
8. Save as **TRIANGLE PEG** (.ipt) in this path:
My Documents→**Inventor**→**Inventor Projects**→**Project 2**
See **Figure 3A**.



Standard.ipt

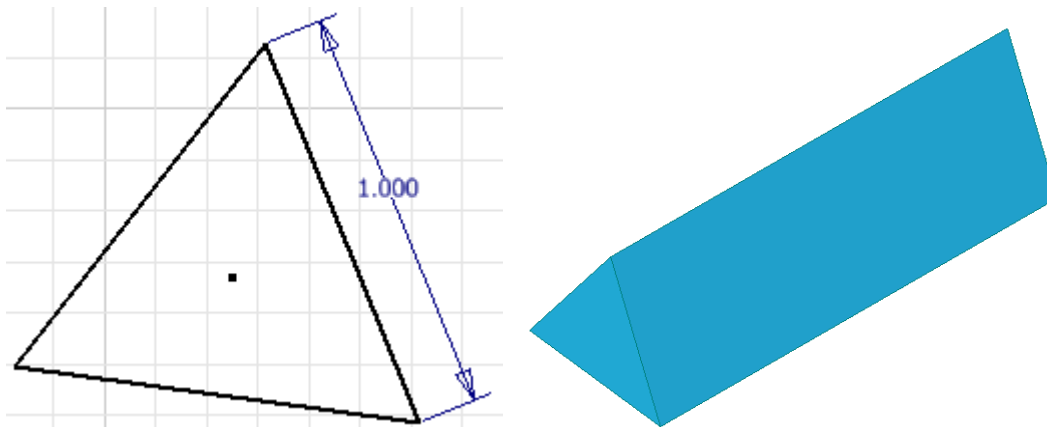


Figure 3A: Triangle Peg

MR. SHRILLA'S PEGBOARD TOY PROJECT

1. Open a new **Part File**.
2. Create a **pegboard** part $\frac{3}{4}$ " (Height) x $5\frac{3}{4}$ " (Width) and extruded 3." Create holes that are the same sizes as the round, square and triangle pegs you designed. The holes should be properly centered both vertically and horizontally within the rectangular base.
3. Change the **As Material** to **Wood (pine)**.
4. Save as **PEGBOARD (.ipt)** in :
My Documents→**Inventor**→**Inventor Projects**→**Project 2**
See Figure 4.

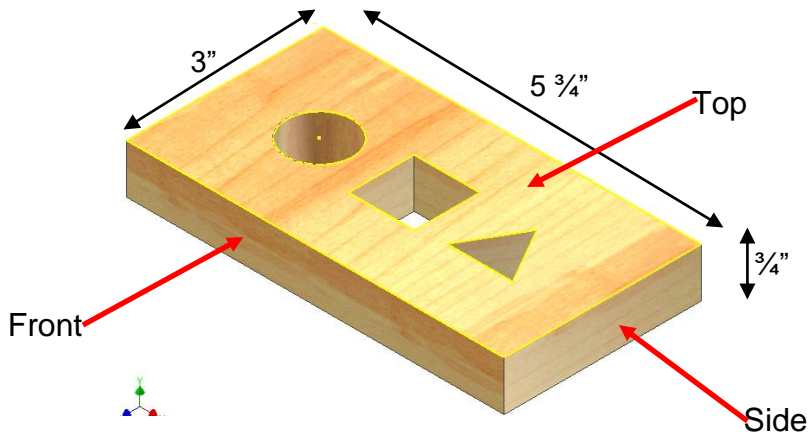



Figure 4: Pegboard

HINTS FOR MAKING THE PEGBOARD

ALWAYS START WITH THE FRONT VIEW, THEN WORK ON THE TOP, THEN FINALLY THE RIGHT SIDE. So for the pegboard you will first make a rectangle $\frac{3}{4}$ "H x 5.75W then extrude it to a depth of 3".

5. When sketching the TOP you will need to make a circle, a square and a triangle, then extrude (cut) them all to $\frac{3}{4}$ ".
6. Use the Parallel Constraint key  to align the base of the triangle with the bottom edge of the top.

IMPORTANT: The circle, square and triangle **MUST** be centered from the top and bottom **AND** from the left-to-right sides. Your sketch layout **MUST** have dimensions as shown in FIGURE 4A.

MR. SHRILLA'S PEGBOARD TOY PROJECT

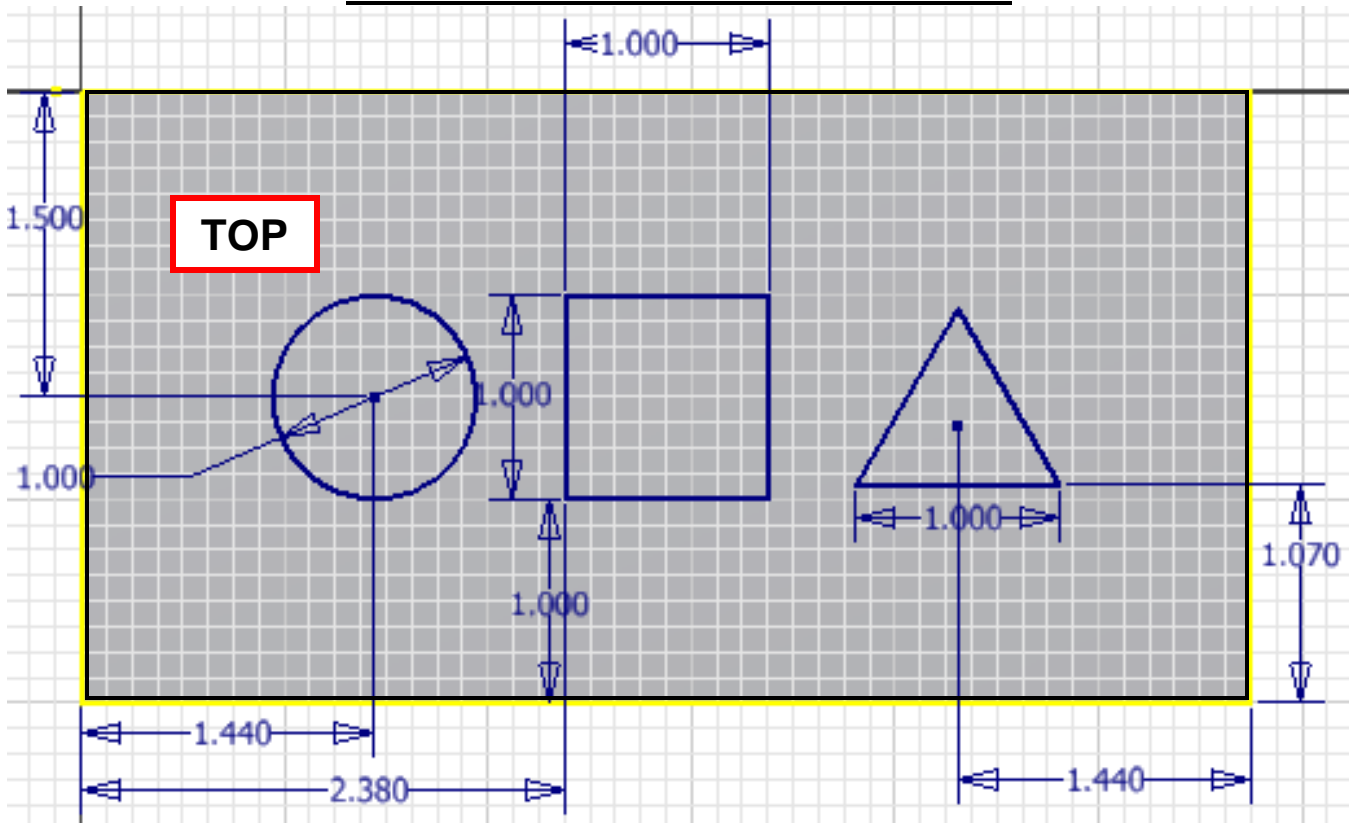


Figure 4A: Top View Sketch Dimensions

1. Now extrude with Cut to a depth of $\frac{3}{4}$ ".
2. You do not have any work to do on the right side of the pegboard.
3. **Save** this as **PEGBOARD** (.ipt) in the same folder as your other two parts.

MR. SHRILLA'S PEGBOARD TOY PROJECT

The End(s) of the Pegboard Toy



1. Open a new **Part File**.
2. Create a **.75" W x 5.75" H** rectangle as shown in **Fig. 4B**.
3. Use the **Line tool**  and the **Trim Constraint tool**  to cut out the notch on the left side as shown in **Fig. 4C**.
4. Extrude it to a 3" depth, then change the **As Material** to **Wood (Pine)** as shown in **Fig. 4D**.
5. Save as **END (.ipt)** in this path:
My Documents→**Inventor**→**Inventor Projects**→**Project 2**



Figure 4B

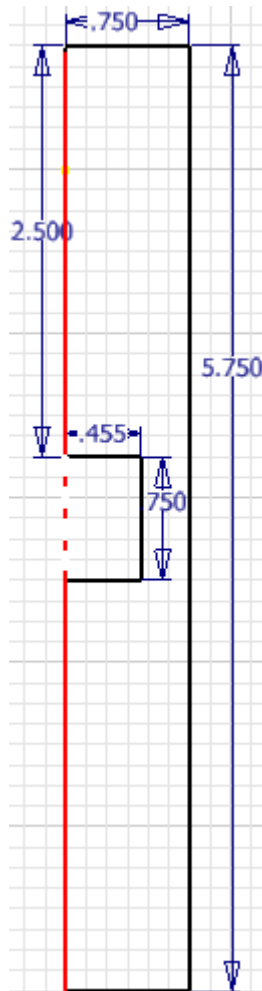


Figure 4C

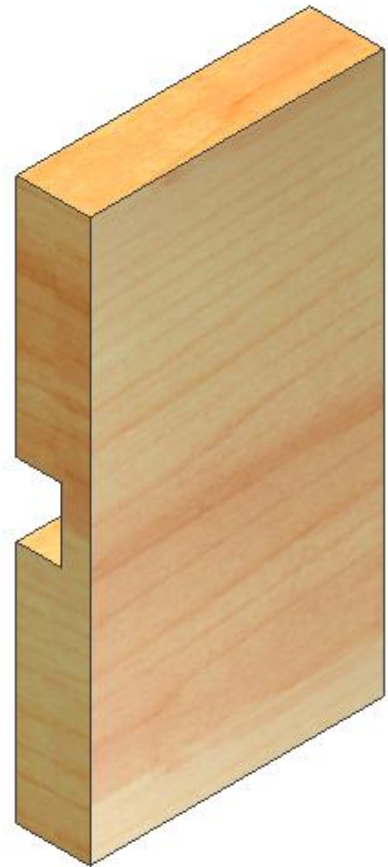


Figure 4D Finished End

Now the we have all our parts built – it's time to assemble them into a finished produce!

MR. SHRILLA'S PEGBOARD TOY PROJECT

Creating an Assembly of Parts

1. Open a new **Assembly File** (Standard.iam).
2. Save as **PEGBOARD TOY** (.iam). in the folder **My Documents**→**Inventor**→**Inventor Projects**→**Project 2**
3. In **Panel Bar**, select **Place Component**.
4. Open the folder where you have the pegboard part saved. Select it and click on Place.
5. **Place** the pegboard part by right-clicking and then select **Done**. Now place the round, square and triangle peg parts in the drawing area. Finally, place two copies of the End part, right-click and select **Done** for each part. See **Fig. 5**.

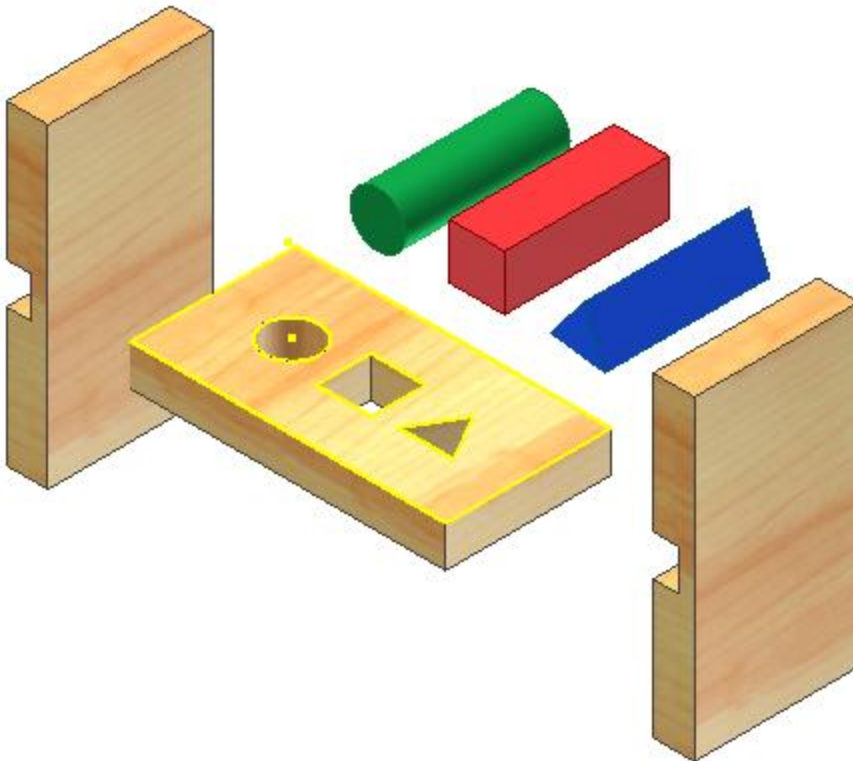
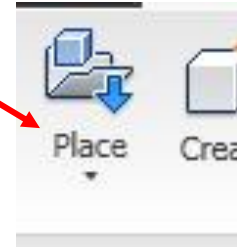


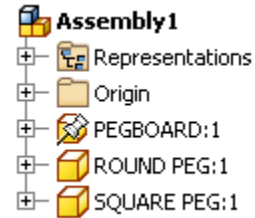
Figure 5: Pegboard with round and square pegs

SAVE YOUR WORK AND THEN CONTINUE.

MR. SHRILLA'S PEGBOARD TOY PROJECT

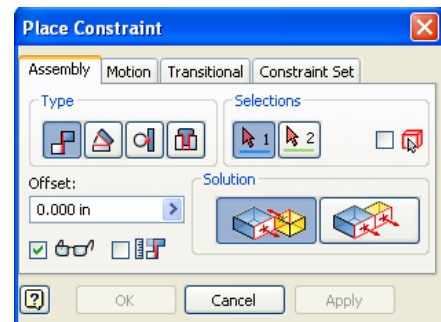
Look in **Browser** (in the left pane) to see if the pegboard is **grounded**. If so, it will have a thumbtack on the object. If not, right click on its icon and select **Grounded**

Note: We **ground** parts so they will not move in relation to other parts. This is really important when assembling parts.



Now you will place the parts in the pegboard. Constraints will align the parts in the holes and keep them there.

1. First you will place the round peg in the hole. In the **Panel Bar**, select **Constrain** from the assembly panel menu. Select the Mate buttons in the Constraints window as shown. Click on the side of the round peg and a red arrow will appear. Now click in the inside wall of the round hole when a red arrow appears. Click **Apply** then **Cancel**. The peg should now move freely up-and-down through the round hole only.



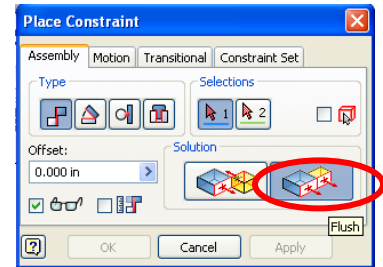
2. Click **Constrain** then **Mate** buttons in the Constraints window as you did in the previous step. Click on the side of the square peg that is facing you, then rotate the entire project around and click on the back side of the square hole that you couldn't see before.. Click **Apply** and then click **Cancel**. Press **[F6]** to go home.
3. Now constrain the side of the open square hole closest to the round peg with corresponding left side of the peg (that you can't see until you spin everything around). Click **Apply** and then **Cancel**. The square peg should now only move up-and-down through the square hole, without flopping around elsewhere. Press **[F6]** to go home.
4. Now constrain the bottom of the triangle (that you can't see) with the front of the triangle hole (that you also can't see). You'll have to flip things around to do that.
5. Finally, constrain the triangle hole closest to the square peg with the left side of the triangle. **Apply** and then click **Cancel**. Press **[F6]** to go home. All three pegs should now slide straight up-and-down through their own holes only.

SAVE YOUR WORK.

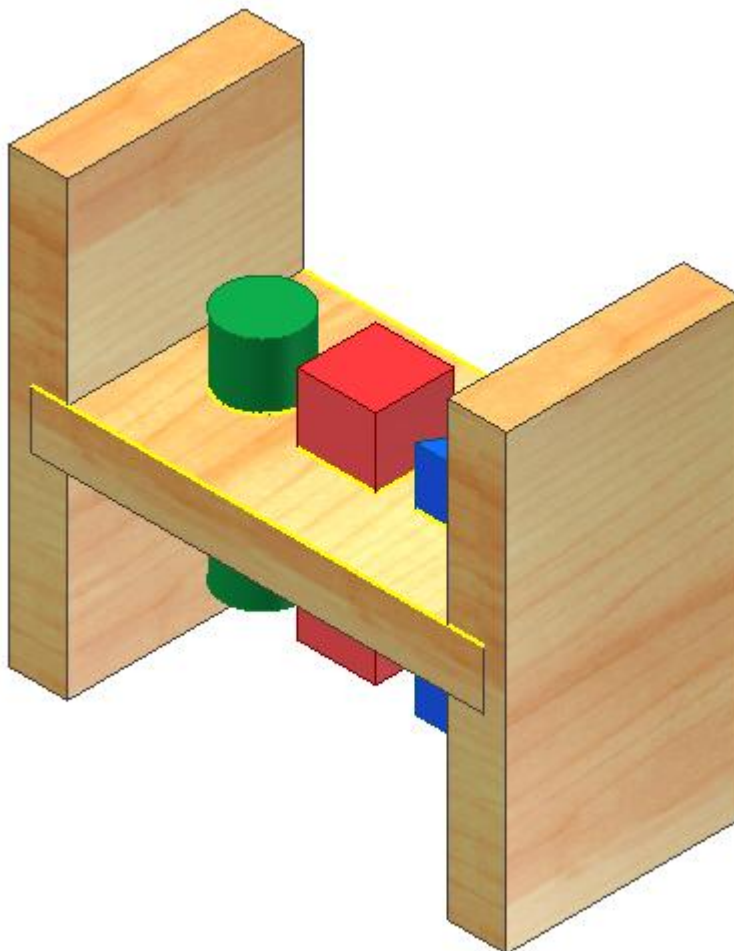
MR. SHRILLA'S PEGBOARD TOY PROJECT

Add the Ends

1. If you don't have two Ends to work with right-click the one end and select **Copy**. Left-click on the other side of the pegboard then select **Paste**.
2. Constrain the front of the pegboard with the front of the right End by selecting **Flush** in the Place Constraint Solution window.
3. Now constrain two other appropriate places with **Mate** instead of **Flush** so that the the End will not move when attempting to do so with the mouse.
4. Constrain the other End to the left side of the pegboard assembly. Hint: start with the inside of the cutout on the End.
5. When you are done the only things that should be moveable are the pegs, sliding in-and-out of their designated holes.



BEFORE YOU MOVE ON, HAVE MR. SHRILLA EVALUATE YOUR ASSEMBLY!



6.

FINISHED PEGBOARD ASSEMBLY

MR. SHRILLA'S PEGBOARD TOY PROJECT

More Parts!

After you have completed the Pegboard Toy, AND Mr. Shrilla has graded it, the Tattered Toy Design Department reviewed your work and came up with another idea to help make the Pegboard Toy more fun.

The Design Department team decided to have you create a mallet for the Pegboard Toy. When creating the mallet, you will be able to demonstrate how well you can sketch and create 3D models.

Because you are a new employee, the Design Department team decided to give you a few ideas to help you with your design of the mallet with the following requirement:

The following steps will guide you in converting your sketch of the mallet into an Inventor Part File:

The mallet head must be 1 ½ in. diameter x 3 in. long.

1. Open a new **Standard.ipt** part file.



2. Sketch a profile of *one-half* of the mallet head. This profile will be revolved in order to create a full image of the mallet head.

3. **HINT:** Draw a rectangle and place correct dimensions (.75"W x 3"H)

4. A. After creating the rectangle, right click *Done*.
B. Create the round circles by clicking Arc, then on the vertical (up-and-down) line.
C. Now move the mouse down the line and click.
D. Next, move the mouse to the *inside* of the rectangle forming an arc that is *tangent* to the line (touching the line on both ends).



5. A. Dimension the arcs to approximately 1/8" (.125") from the top and bottom and 2/5" (.4") in diameter.
B. Click **Coincident Constraint** (near the top) then click on the center of the Arc then the vertical line just to the right of it. Do the same for both arcs. This aligns the center of the arc with the vertical line.



C. Now click on **Trim** on the Modify toolbar and click on the line inside the arc. This will only delete the line inside the arc.

6. Your drawing should look similar to **Figure 9**.

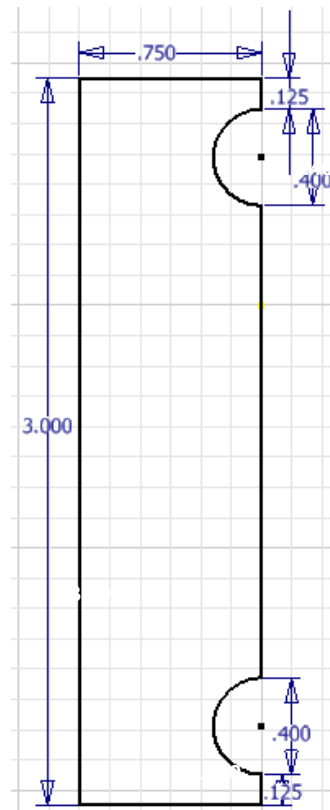
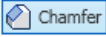


Figure 9: Sketch before constraints

MR. SHRILLA'S PEGBOARD TOY PROJECT

applied

1. Change view to **Isometric** by clicking on **Finish Sketch**.
2. Select **Revolve** in the Create toolbar. Click on the left edge of the sketch when a red line appears. This will revolve and extrude the mallet head to look like **Figure 10**.
3. Place $\frac{1}{16}$ " **Chamfer**  on each end to give the mallet the characteristic look.
4. Click on Chamfer in the Model toolbar. Click on **Edges** in the Chamfer window and change the Distance to $\frac{1}{16}$." Click on the top and bottom edges of the mallet head when they turn red. This will give you a preview of what will be chamfered. See **Figure 11**. Click **Apply**.
5. Save drawing as **MALLET HEAD** (ipt) in the correct folder.

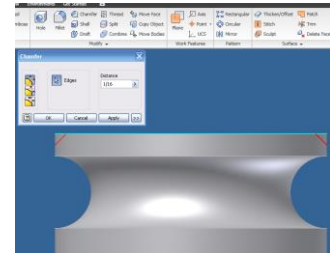
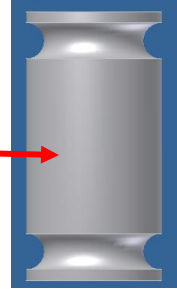
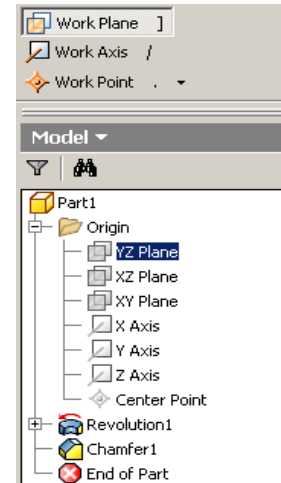
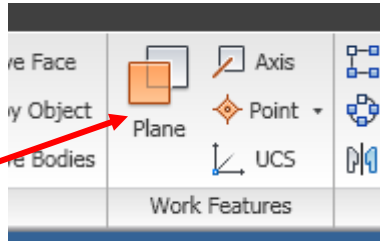


Figure 11

Work Plane on the YZ Plane

To drill a threaded hole we have to place a **Work Plane** on the *YZ plane* and *tangent* to the *circumference* of the Mallet head. Here's how:



6. Select **Plane** in the **Work Features** toolbar.
7. In the Browser window, click on the + beside **Origin** to expand the folder and click on the **YZ Plane**.
8. Click on the circumference of the mallet so the work plane will be made tangent to it (Fig. 12).

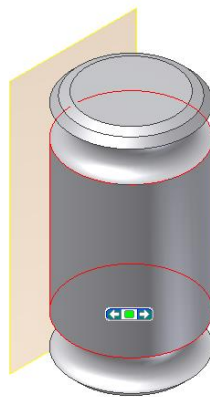


Figure 12: Mallet with work plane tangent to it

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1. Click on Create 2D Sketch and click on the yellow edge of the **Work Plane**. This will place a Sketch Plane on the work plane you just created.
2. Click on **Project Geometry** and click on the inside edges of the mallet head. Shown in **Figure 13** in purple.
3. Place and locate a Point in the middle of the Mallet and apply Dimensions shown in **Figure 13**.
4. Click on **Finish Sketch**.
5. Go to View→As Material and change it to **Wood (Oak)**.

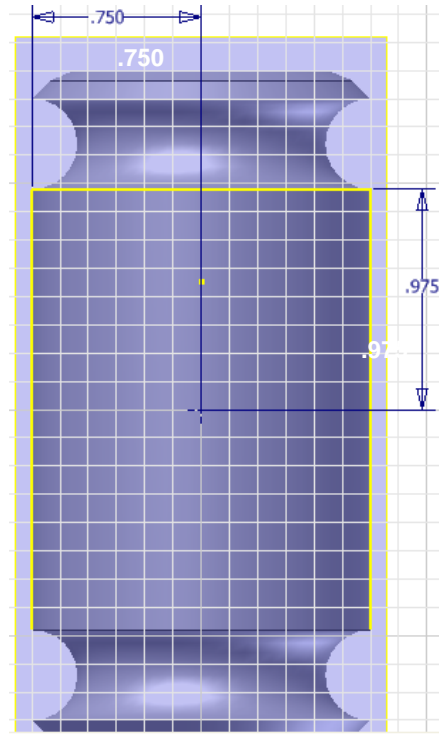
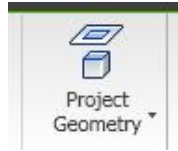


Figure 13

5. Create a drilled & tapped Hole Feature on the point created above. See Figure 14.

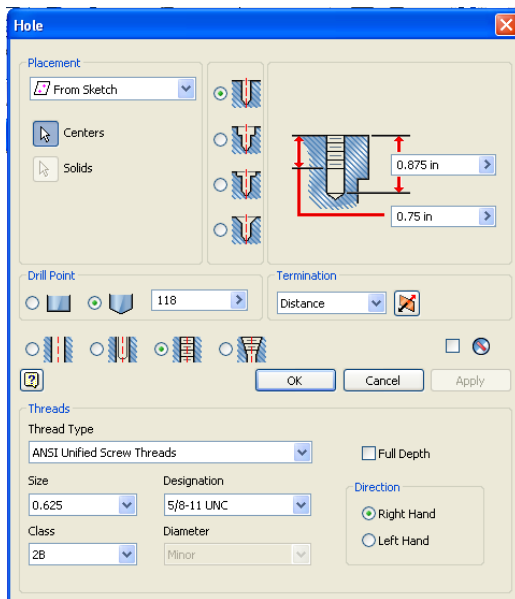


Figure 14: Specifying hole features

The **specifications** for this hole are:

- 0.875 drill depth
- 0.625 tap depth
- 5/8 Size
- ANSI Unified Screw Threads 5/8-11 Designation

6. In the Browser, right-click on Work Plane under the Chamfer and turn off visibility.
7. **Save your work.**

Creating the Mallet Handle

1. Open a new **Part File**.
2. Create a circle that is $\frac{5}{8}$ " diameter.
3. Click on Finish Sketch and Extrude it 8" long.
4. Change it to **Wood (Oak)**.
5. Save drawing as **MALLET HANDLE** (ipt).
6. Place 0.0625 *Chamfer* on each end.
7. Click on *Thread* in the toolbar. You may need to uncheck Full Length in the Thread window. Change the length of the thread to .675" and click on one end of the handle to match the hole in the Mallet Head. See **Fig. 15**.
8. **Save** again.

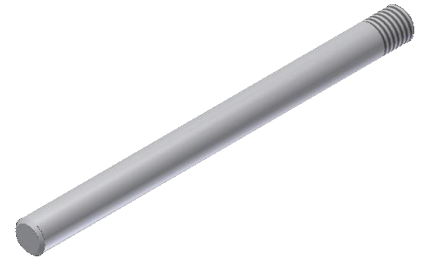


Fig. 15: Mallet Handle

Assembly of Mallet Head and Handle

9. Open a new **Assembly File**.
10. In the **Panel Bar**, select **Place Component**.
11. Place the **MALLET HEAD** and the **MALLET HANDLE** in the graphics window.



Figure 16: Mallet Head and Mallet Handle

MR. SHRILLA'S PEGBOARD TOY PROJECT

1. Ground the mallet.
2. Place an **Insert Constraint** between the Head and Handle.
3. Be sure to *offset* the Handle 0.250" to allow for the bottom part of the hole in the Mallet Head that was not threaded.
4. Save assembly as **Mallet** (iam). See Figure 18

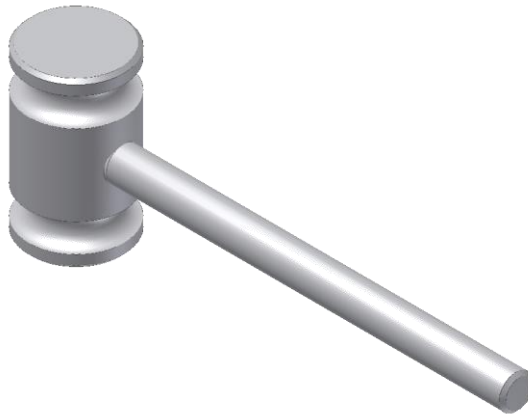
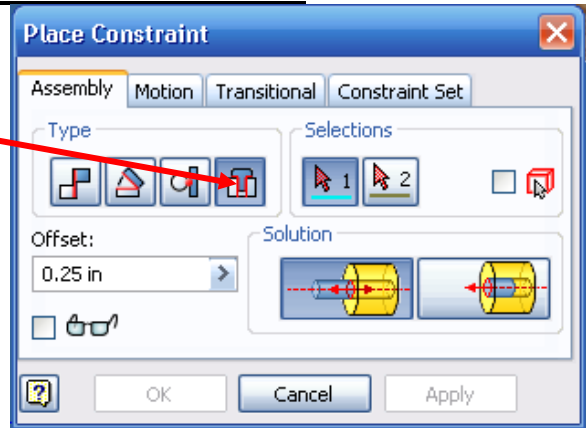


Figure 18: Completed Mallet

Creating a Drawing

Now that you have completed the Pegboard Toy and Mallet, the designers would like to see a drawing of the design. Please refer to Mr. Shrilla's instructional video(s) and the worksheet for it.