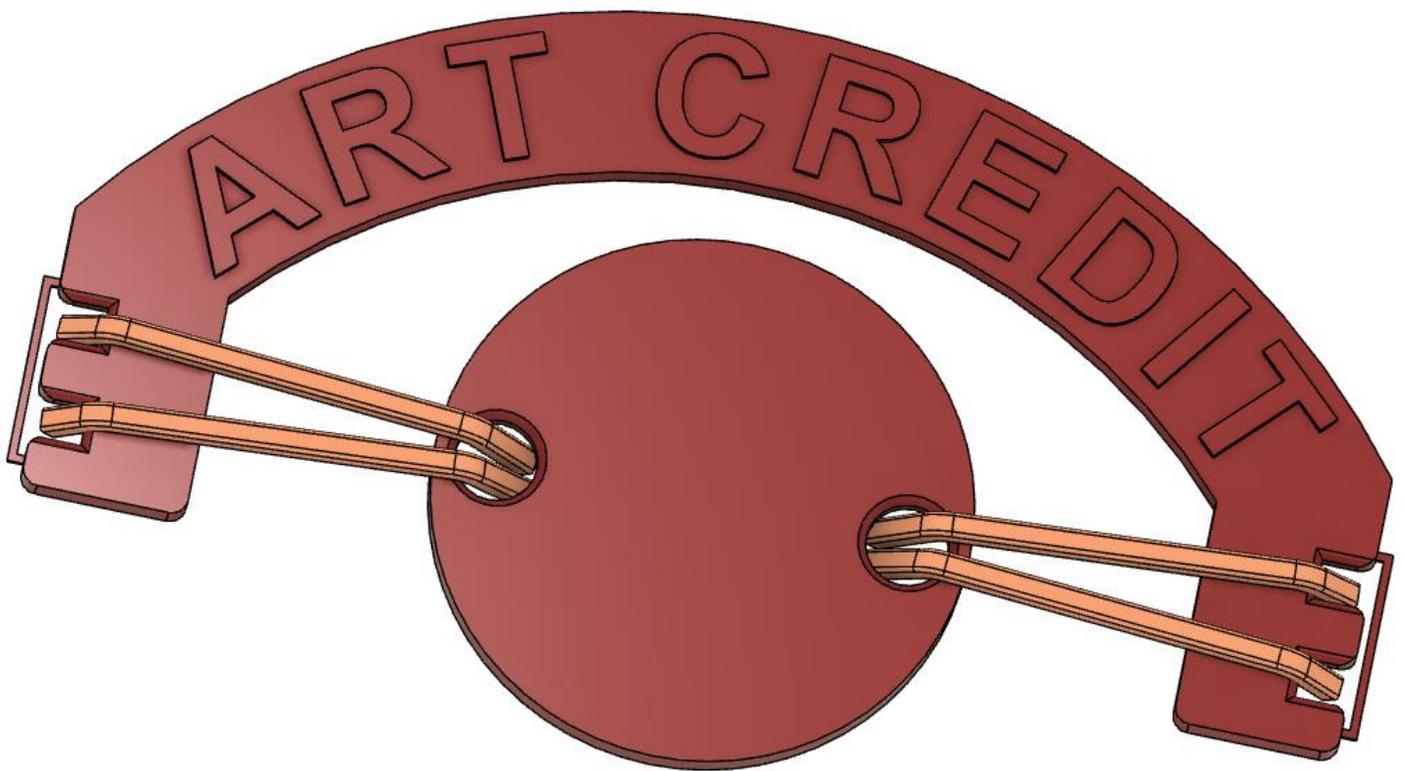


Scare your friends with a

## Letter Prank Device



# Today's Lesson is Sponsored by Space Camp



U.S. Space & Rocket Center  
One Tranquility Base  
Huntsville, AL 35805

## Train like an astronaut and vomit !

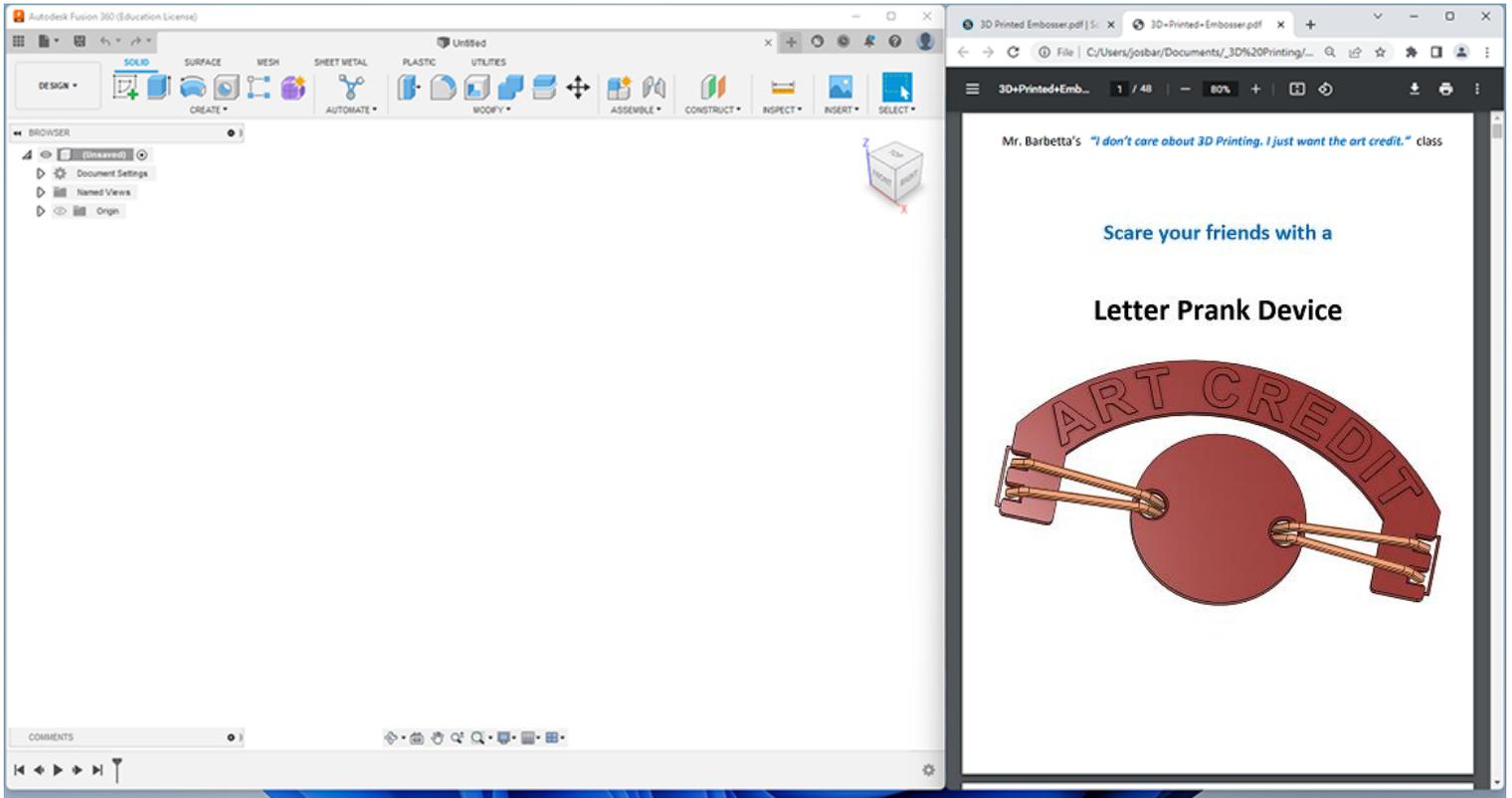


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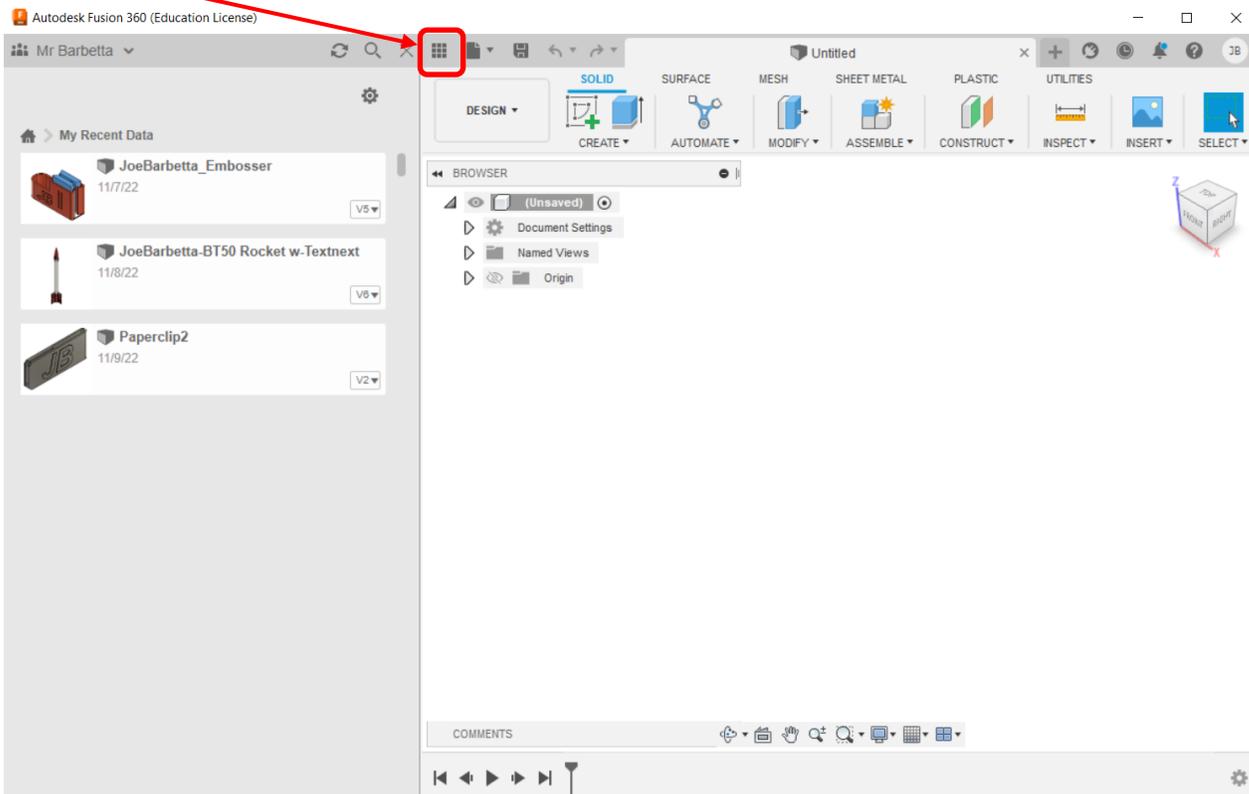
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## Using This Document

The best way to follow this document is to **reduce the width of the Fusion 360 window** and have this pdf document open in Chrome browser as shown below. This document can be **downloaded from Schoology** and then **dragged into Chrome** and scaled down to 80%.

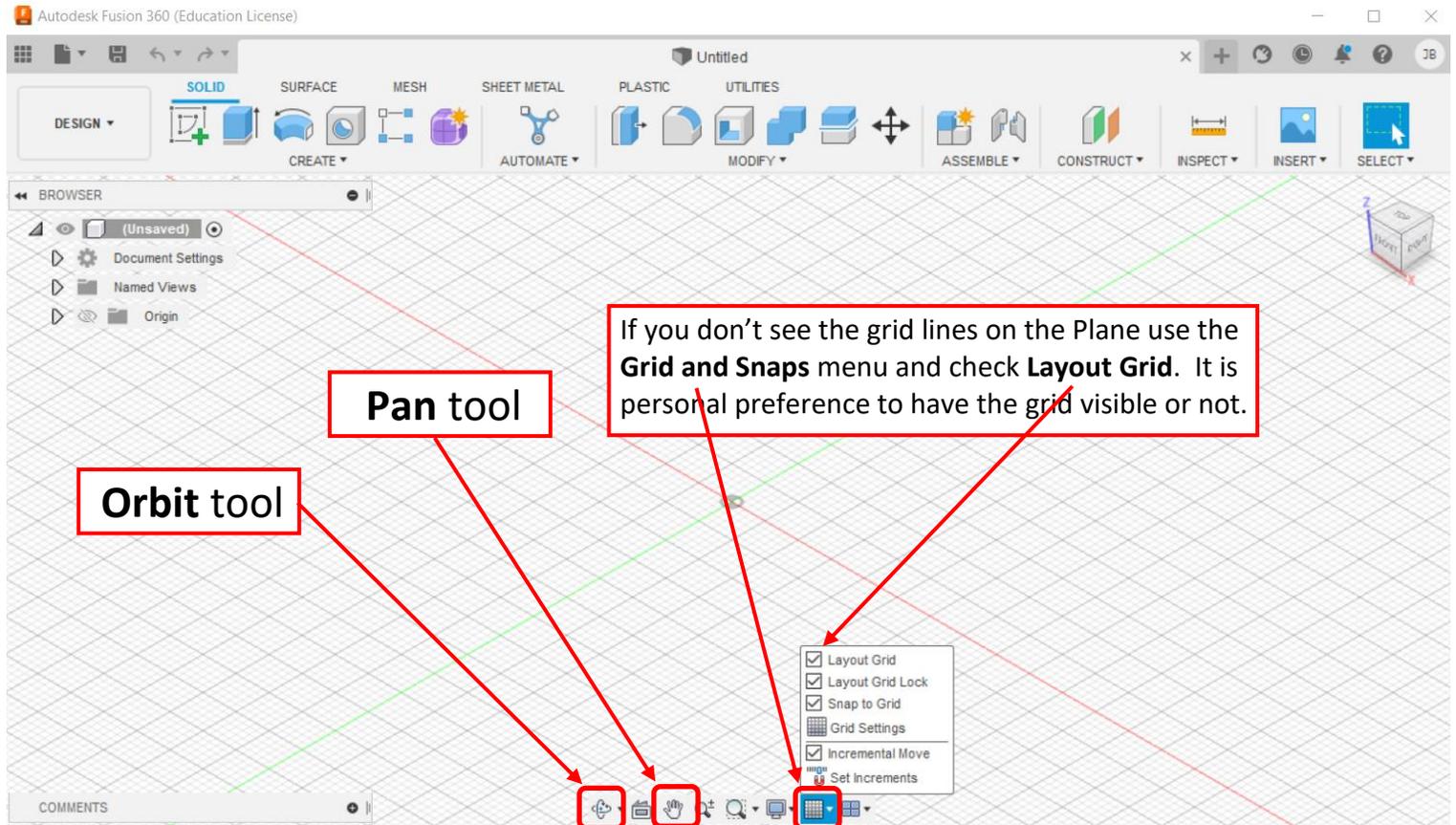


The Fusion 360 window will not allow its width to be reduced much so for smaller computer screens a trick is to click on the **Data Panel icon** and then move the window to the left with the Data Panel off the screen.



## Changing the View of a Design (information only)

- if you don't see a grid in the Fusion 360 window, as shown below, click on **Grid and Snaps** and check **Layout Grid**. Displaying the *Layout Grid* is a matter of preference. When designing for 3D printing, it can be used to represent the *build plate*.
- click on the **Orbit** tool and click somewhere on the **Grid** to practice rotating and changing the angle of the view.
- click on the **Pan** tool and then on the **Grid** to practice moving the view laterally.
- after using the *Orbit* or *Pan* tool one must press the **Esc** key to exit that mode.
- use the **Mouse Wheel** to practice Zooming in and out.

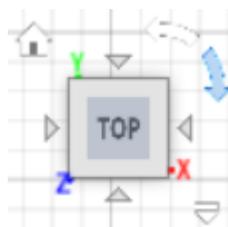
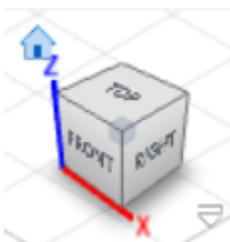


Here is a close-up of the View Cube at the top right of the window.

- click on the **View Cube** and move the cube while holding the mouse button down. This is another way to rotate the view.
- click on the **Top** of the View Cube and note how the view just jumped to a Top View.

The View Cube now resembles that on the right.

- click on the **Curved Arrows** at the upper right of the View Cube and practice Rotating the View.
- click on the **Arrows** at the sides of the View Cube to practice jumping to various Views.
- click on the **Home** icon to the upper left of the View Cube. This can always be used to reset the view to the Home View



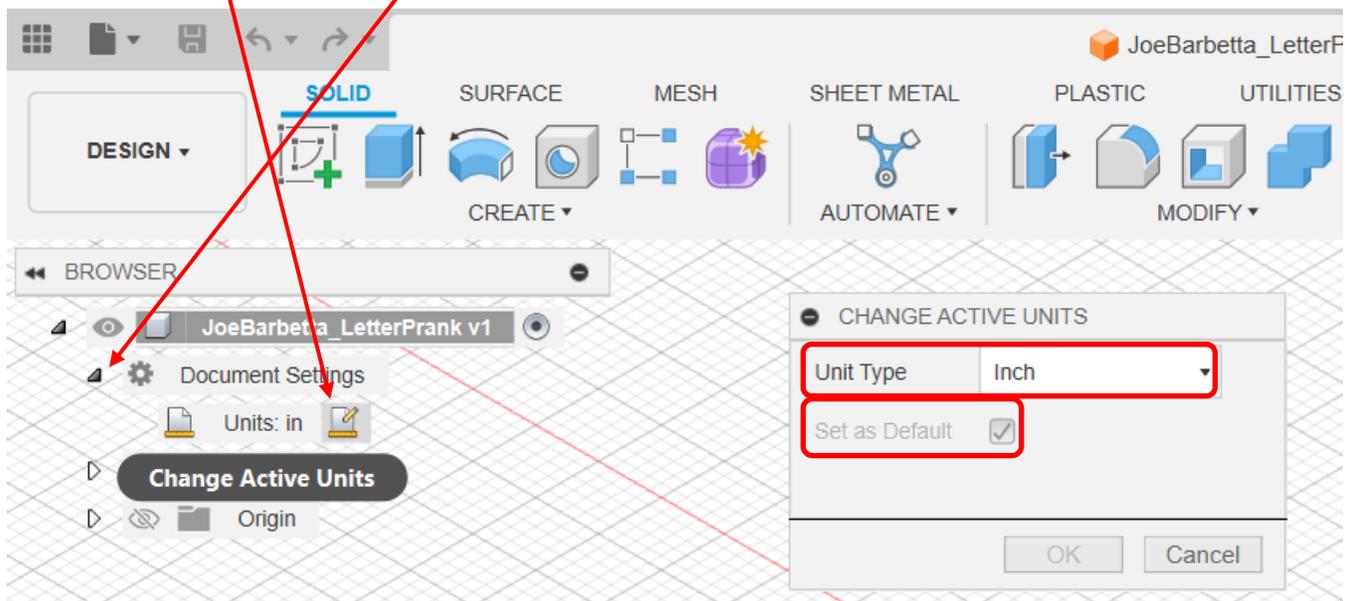
## Starting a Design in Fusion 360 (START HERE)

- open **Fusion 360**. If there is no icon on the Desktop, use the Windows search (magnifying glass icon) and type **fu**
- from top **File** icon select **Save** and name the file.  
Use your name followed by **\_LetterPrank** e.g. **JoeBarbetta\_LetterPrank** (note the use of the underscore)

Note that by default Fusion 360 saves your project to “the cloud”, which are the servers managed by AutoDesk. When you log into Fusion 360 on a different computer, your projects will be available.

As you work save your project occasionally in case Fusion 360 crashes or a squirrel chews through the school’s fiber optic..

- in the left "**BROWSER**" click on the **arrow next to Document Settings**
- click on the **edit icon** that appears to the left when you hover over **Units**
- change **Unit Type** to **Inch** and click **OK**. You can also enable **Set as Default** if it is not grayed out.



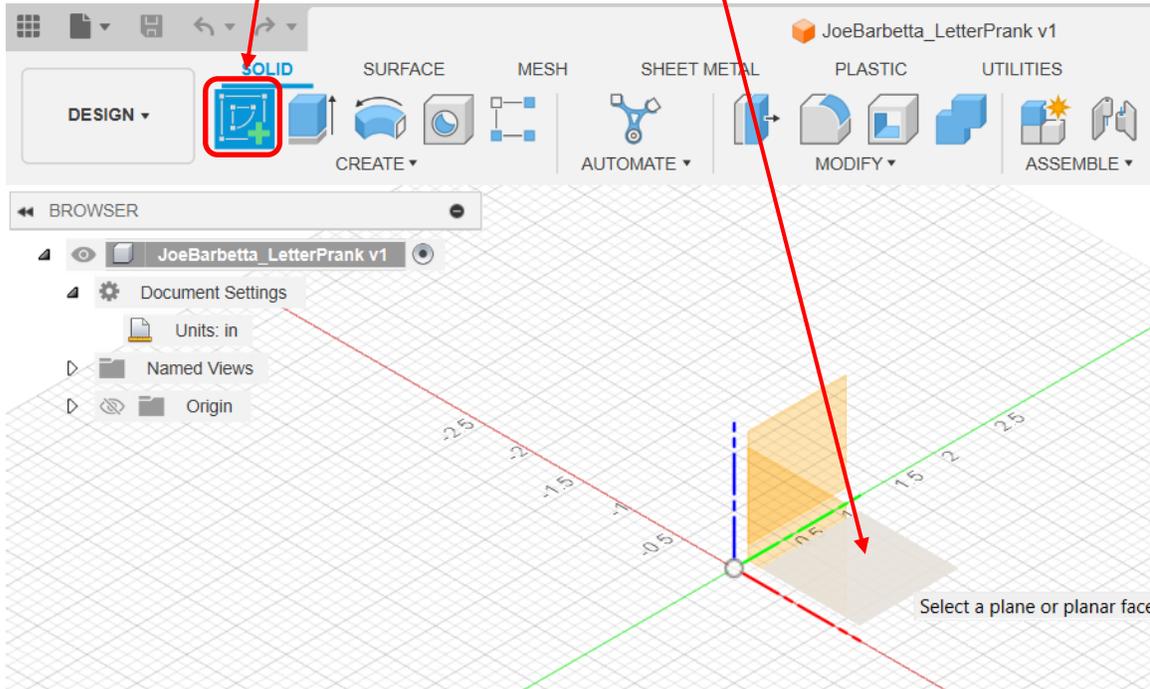
Note that the default units are in mm, which we just changed to inches.

Did you know that the default units have changed over the years? We are using version 360 of Fusion. Version 1 only offered cubits as a unit.

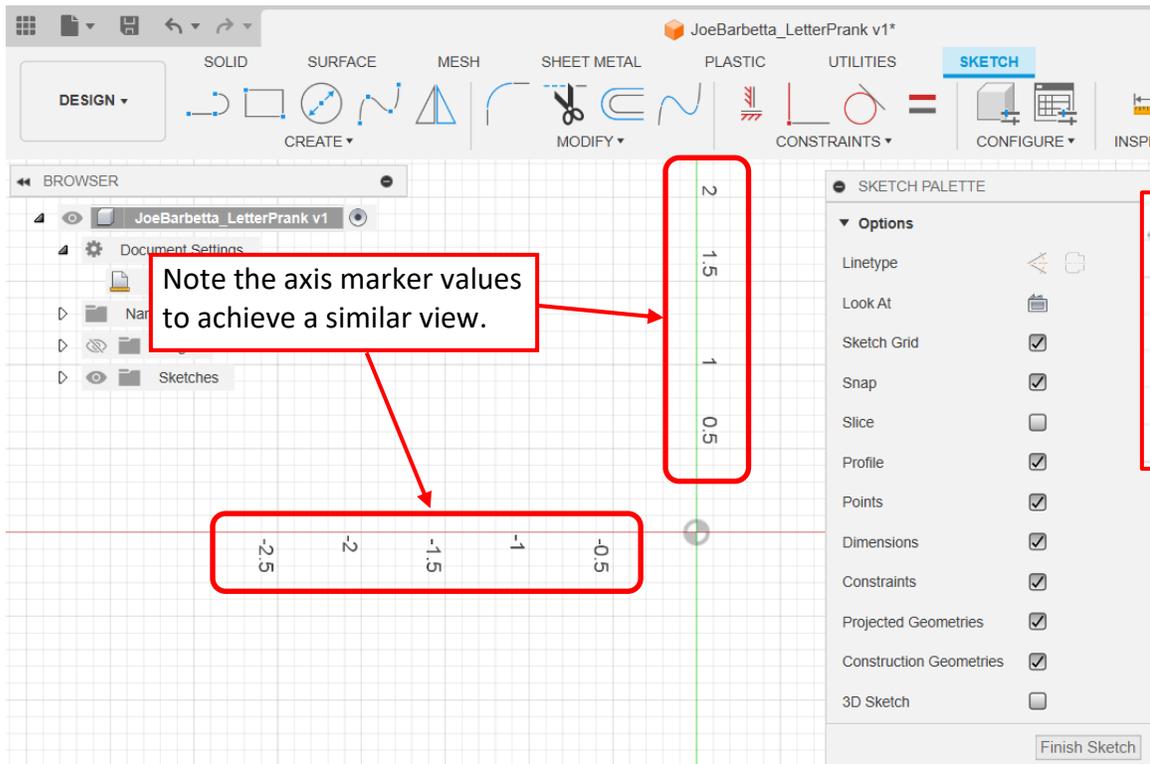
## Creating the First Sketch

Note that a Fusion 360 expert may tell you to create a Component first. Just say "Dude. I'm just making a Letter Prank."

- select the top **Create Sketch** tool and click on the **bottom rhombus** to select the X-Y Plane.  
If a tool can't be found, one can always look in the **CREATE** and **MODIFY** menus for it.

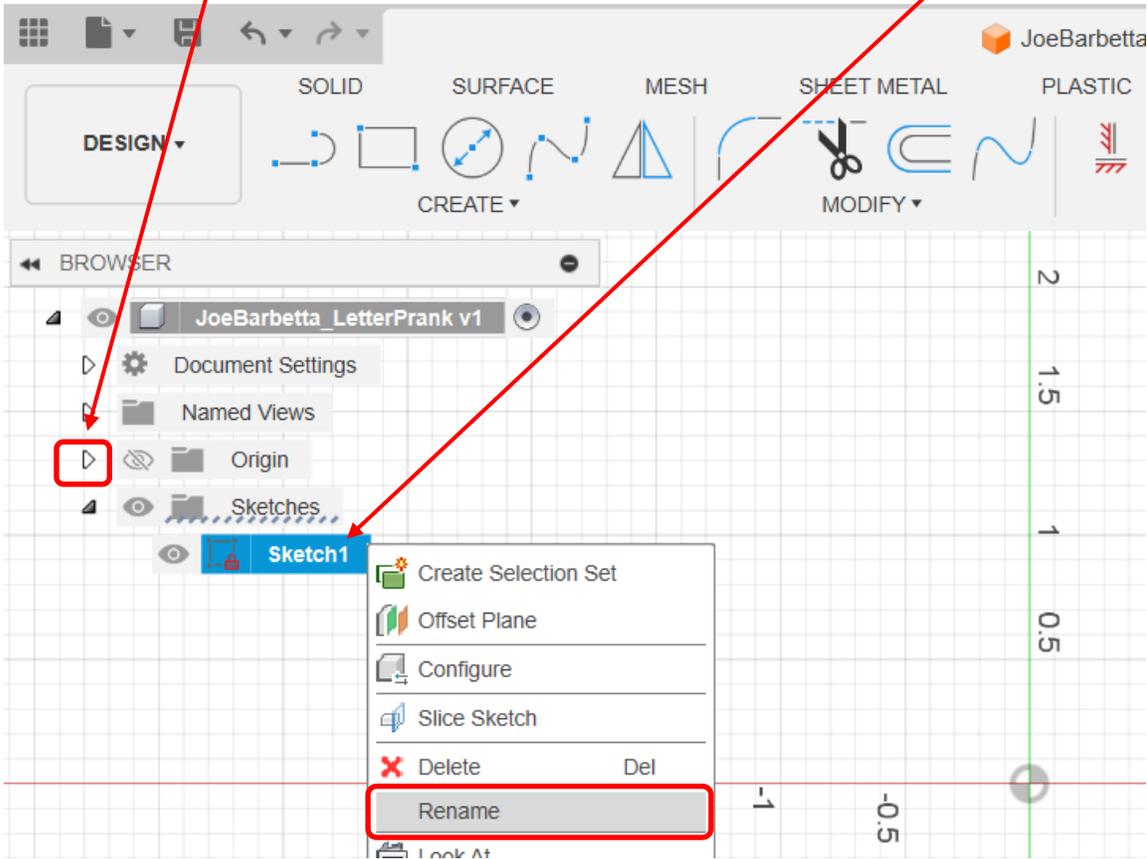


- zoom in as shown below. The scale labels can give an idea of how far one is zoomed in. The **View Cube** should indicate you are sketching on the **Front X-Y Plane**.

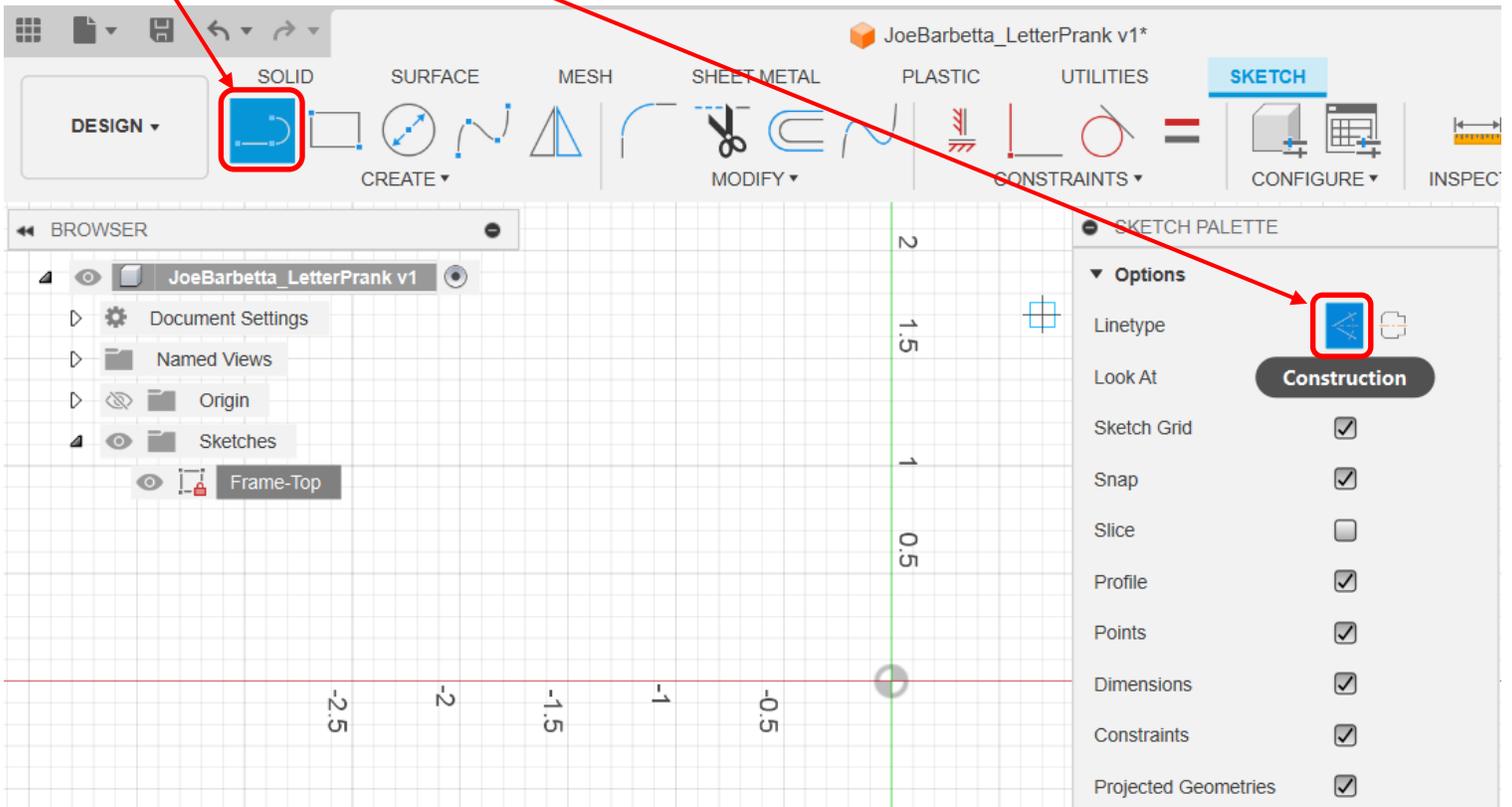


Whenever a new Sketch is created, it should be named.

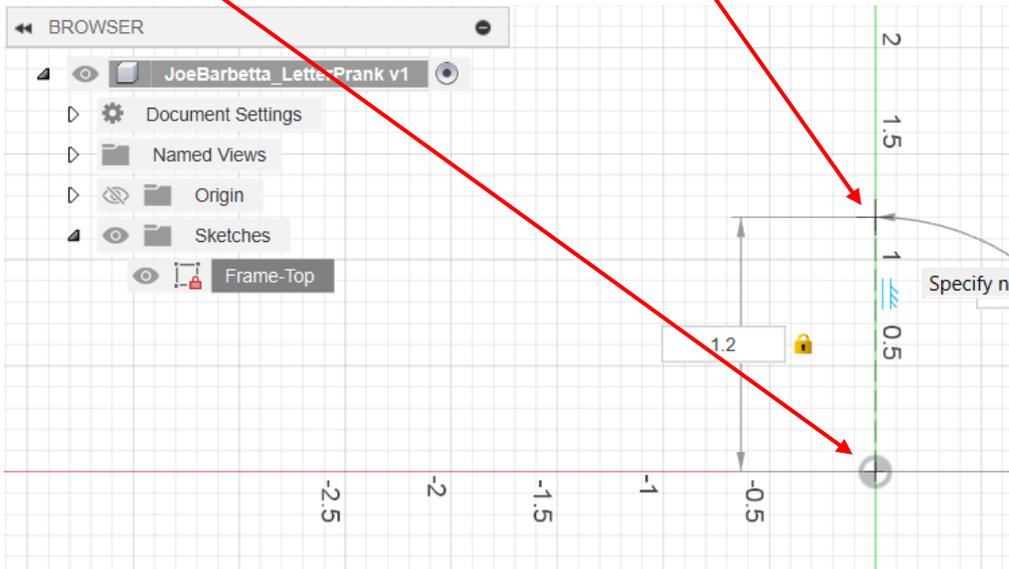
- click on the **arrow** to open the Sketches folder, **right-click** on the default name **Sketch1** and select **Rename**. Change the name to **Frame-Top**.



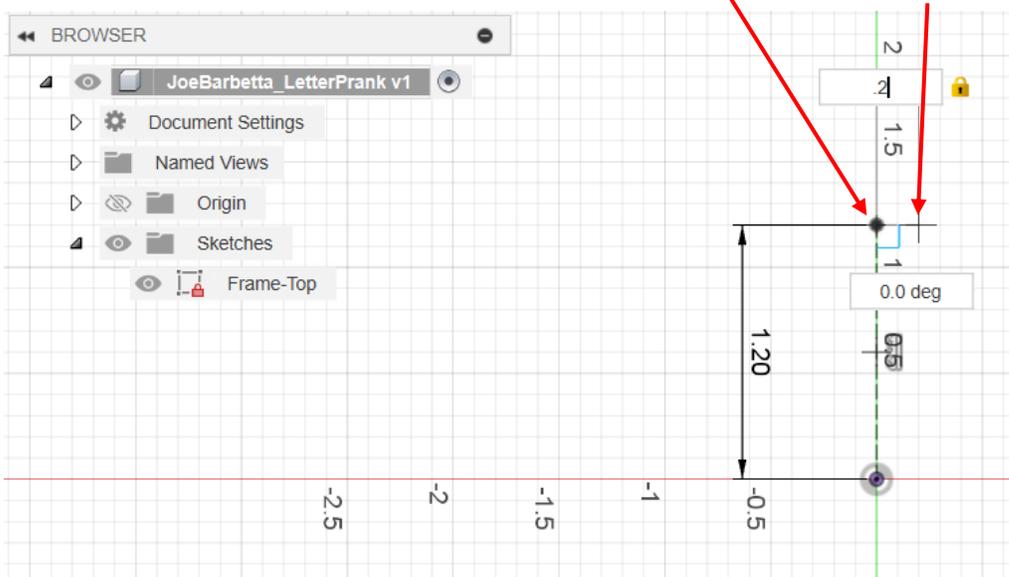
- select the **Line** tool and click on the **Construction** icon for Linetype



- click on the **origin** to start the line and then **extend the line up**. Type **1.2** press Enter.

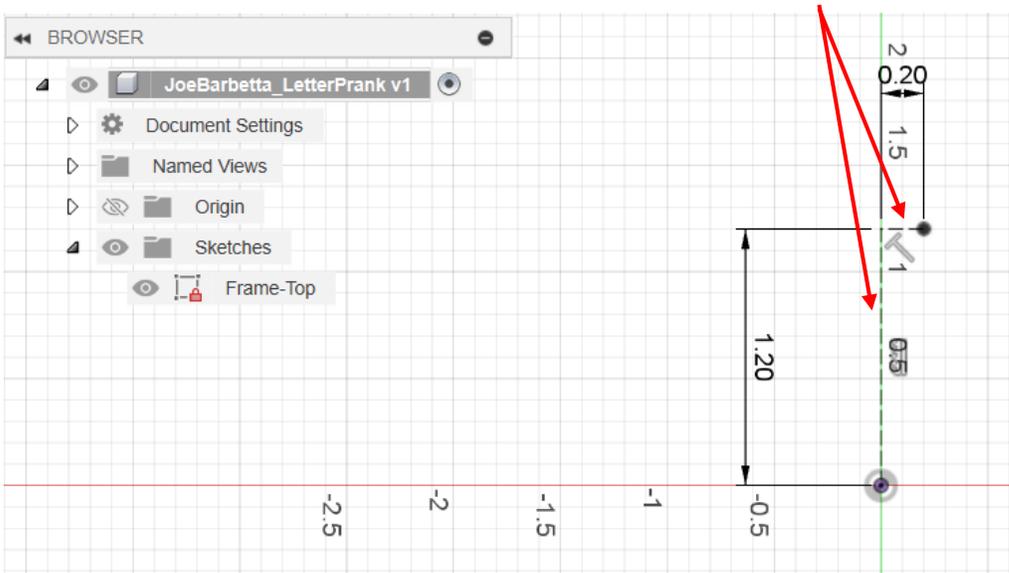


- select the **Line** tool again and start a line from the **last position** and **to the right**. Type **0.2** and press Enter.

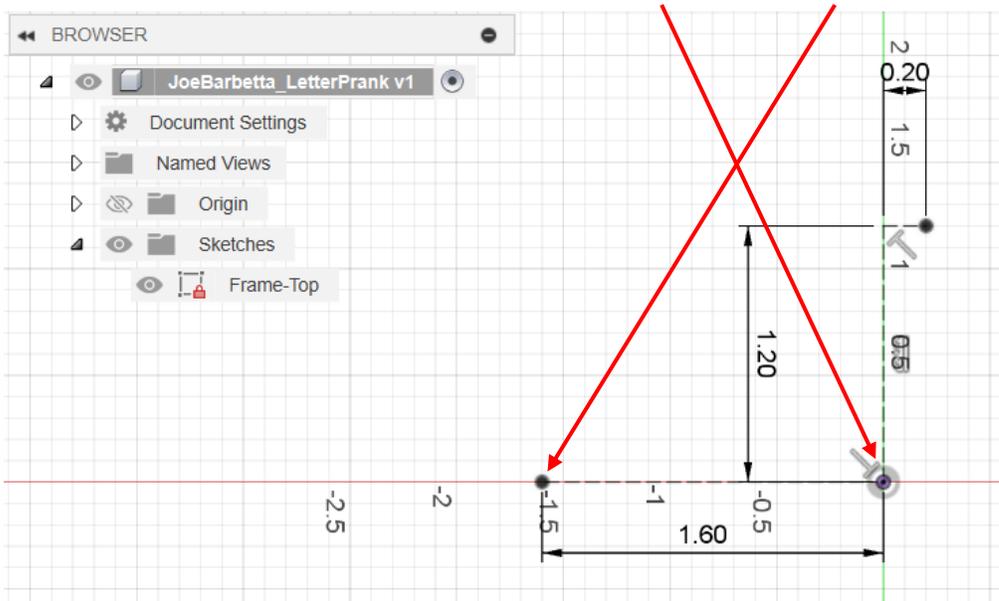


- verify that the Sketch lines are **dashed**. If not the Construction icon click may have been missed.

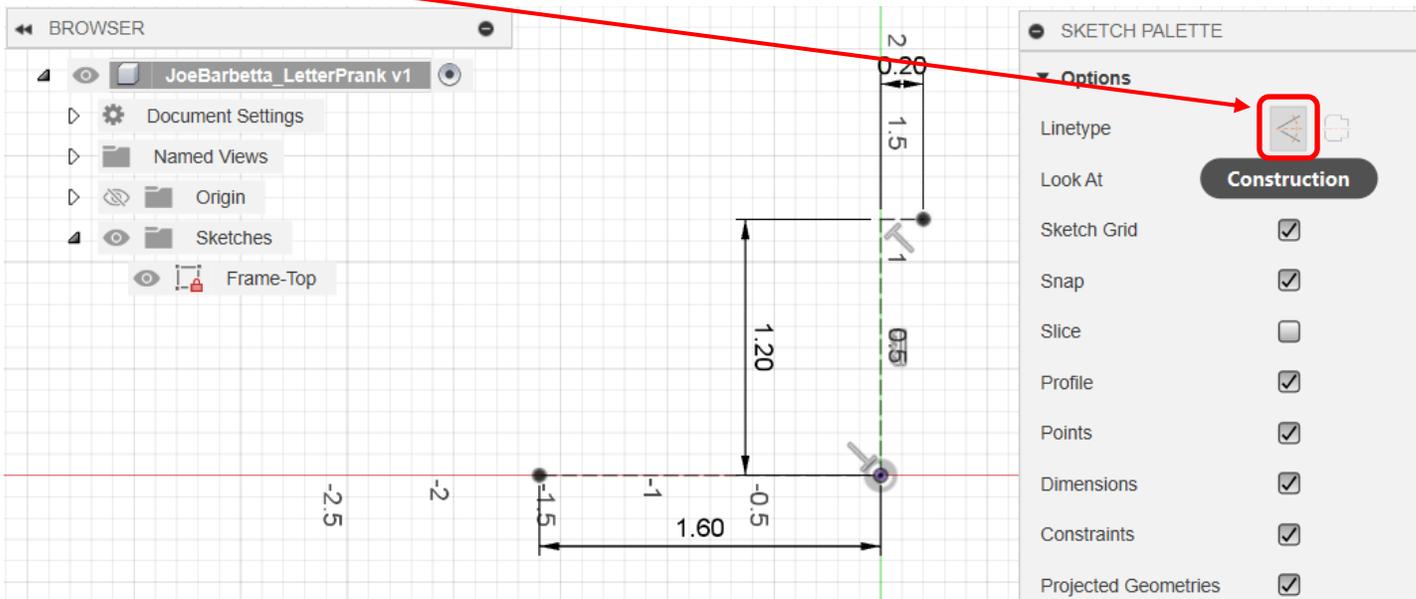
The dimension lines may be different and can be ignored. It's the two dashed lines that are important.



- select the **Line** tool again and start a line from the **origin** and **to the left**. Type **1.6** and press **Enter**.

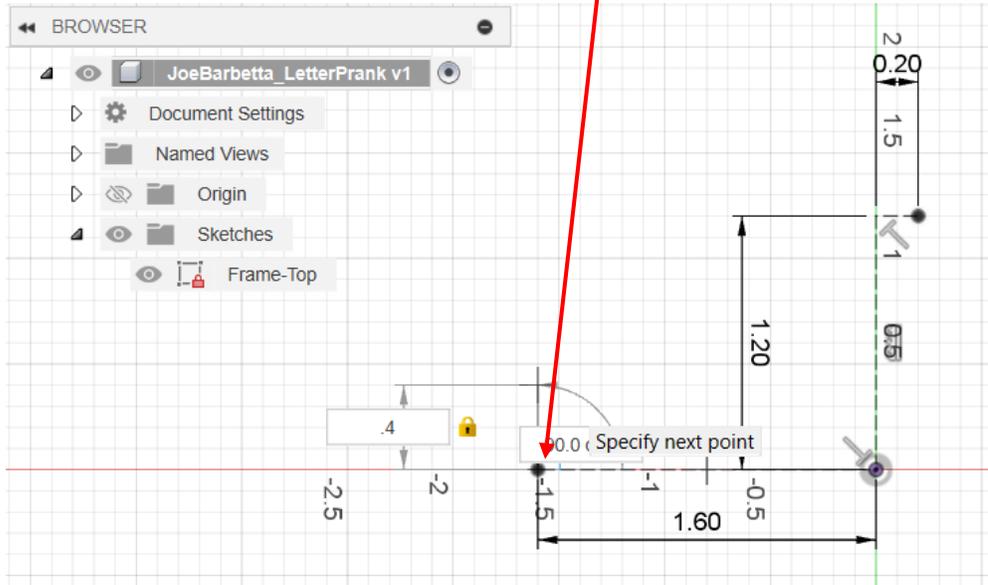


- click on the **Construction** icon again to **remove the blue highlighting**. This will allow you to draw “normal” lines.



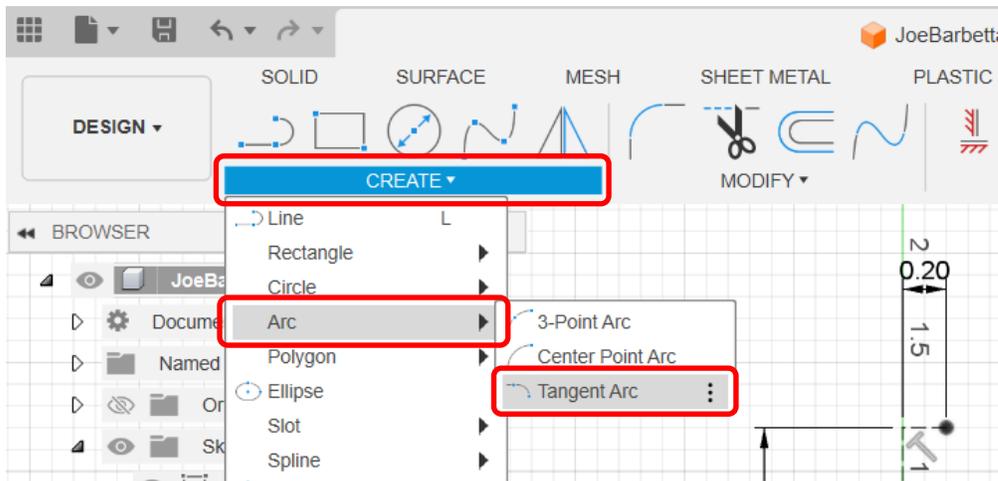
- select the **Line** tool and create a line from the **Origin** and **upward**, type **0.4**, and press **Enter**.

The line just drawn should be **solid** and Not dashed. If not the Construction icon click may have been missed.

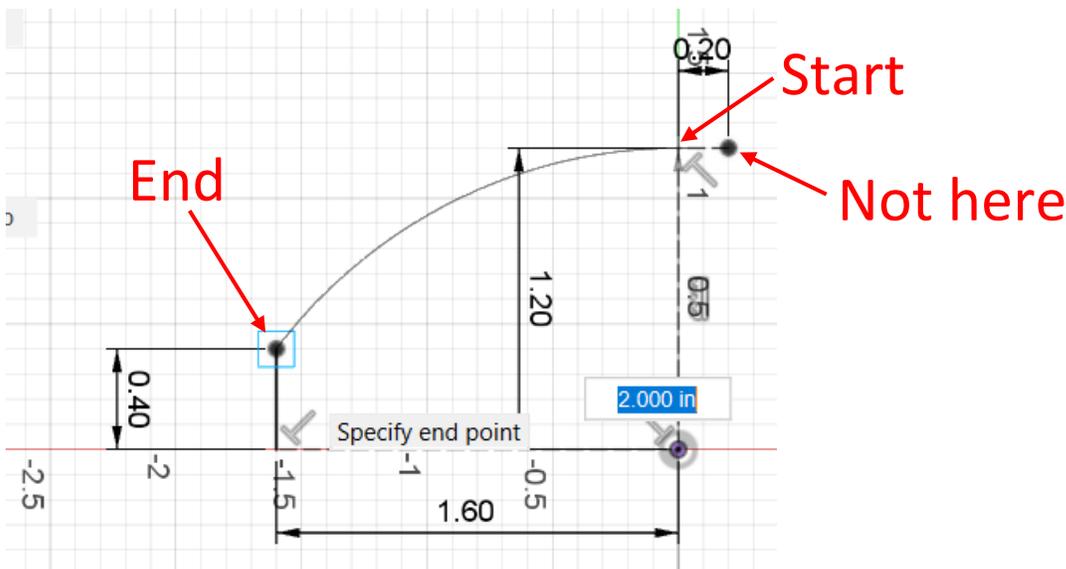


Remember that the **dimension lines may look different**. It is the dashed lines that are important here.

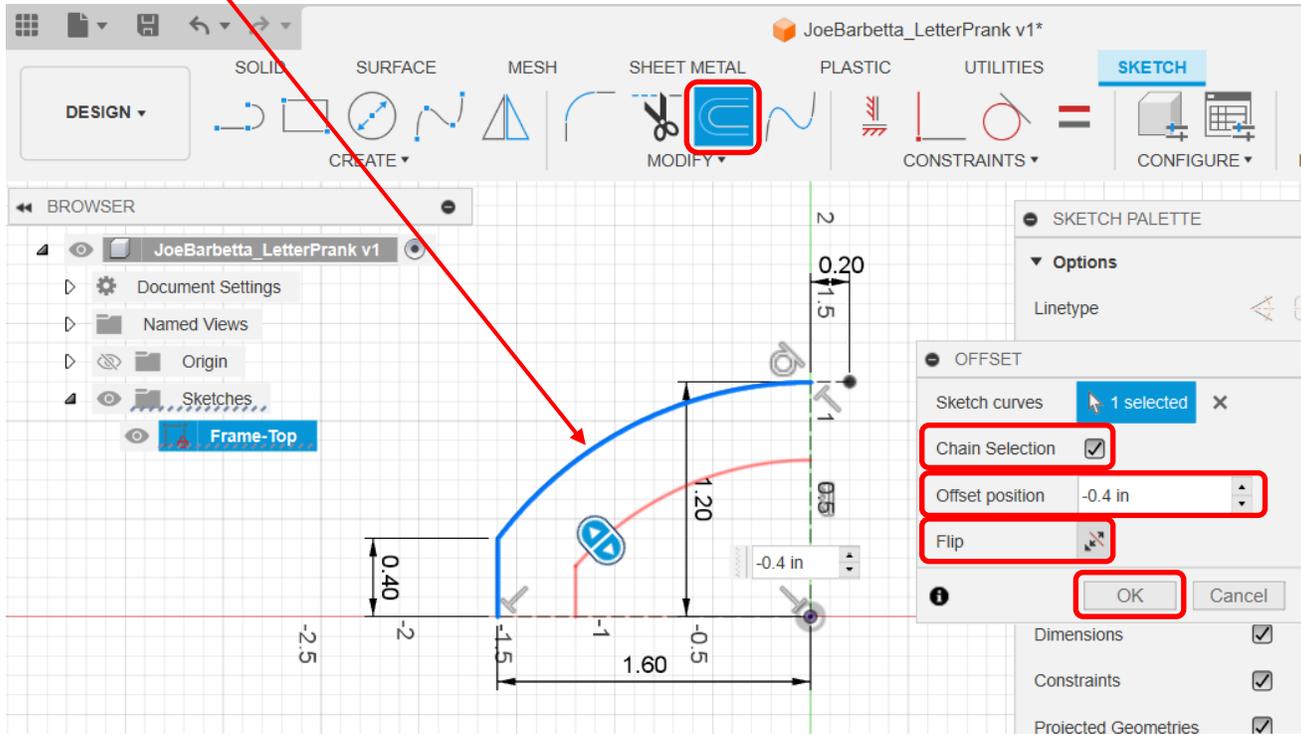
- under the **CREATE** menu, select **Arc** and then **Tangent Arc**.



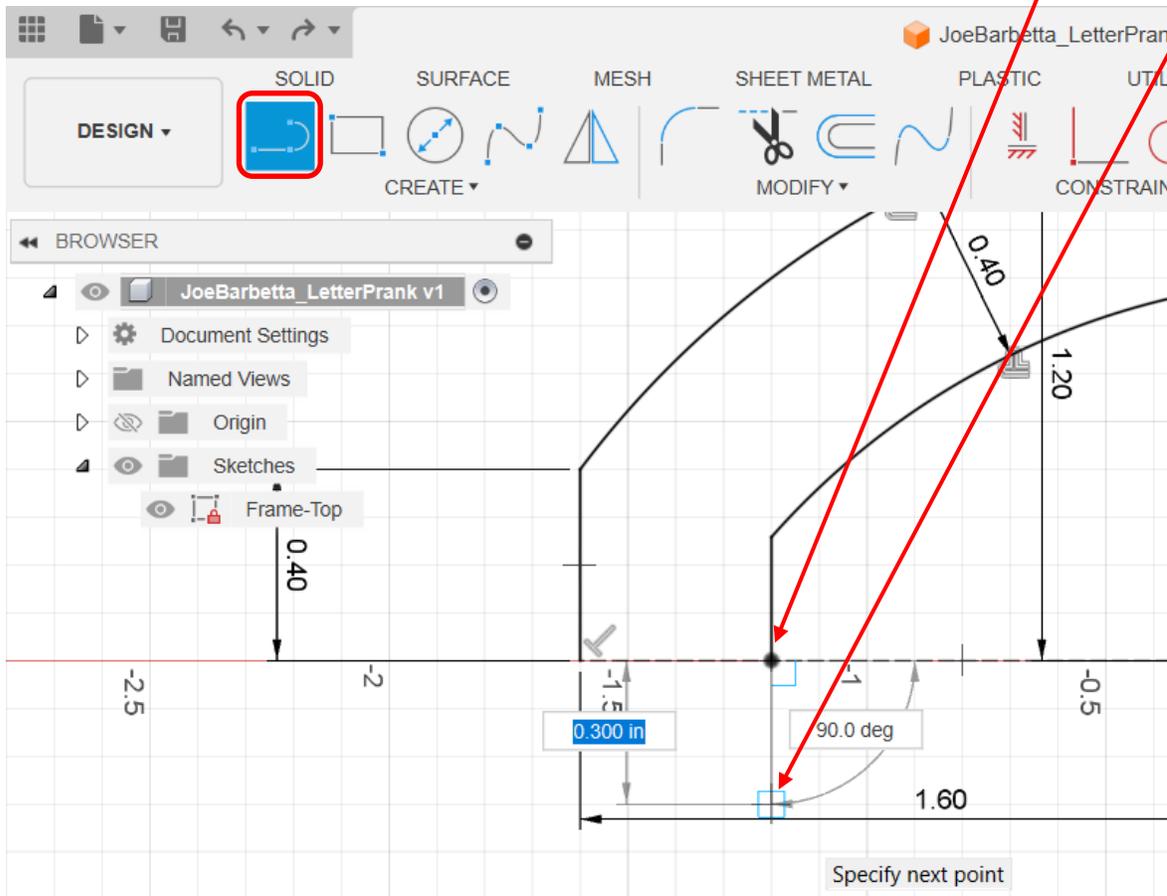
- click on the **intersection of the two dashed lines** to start the arc and then on the **top of the 0.4 line**.



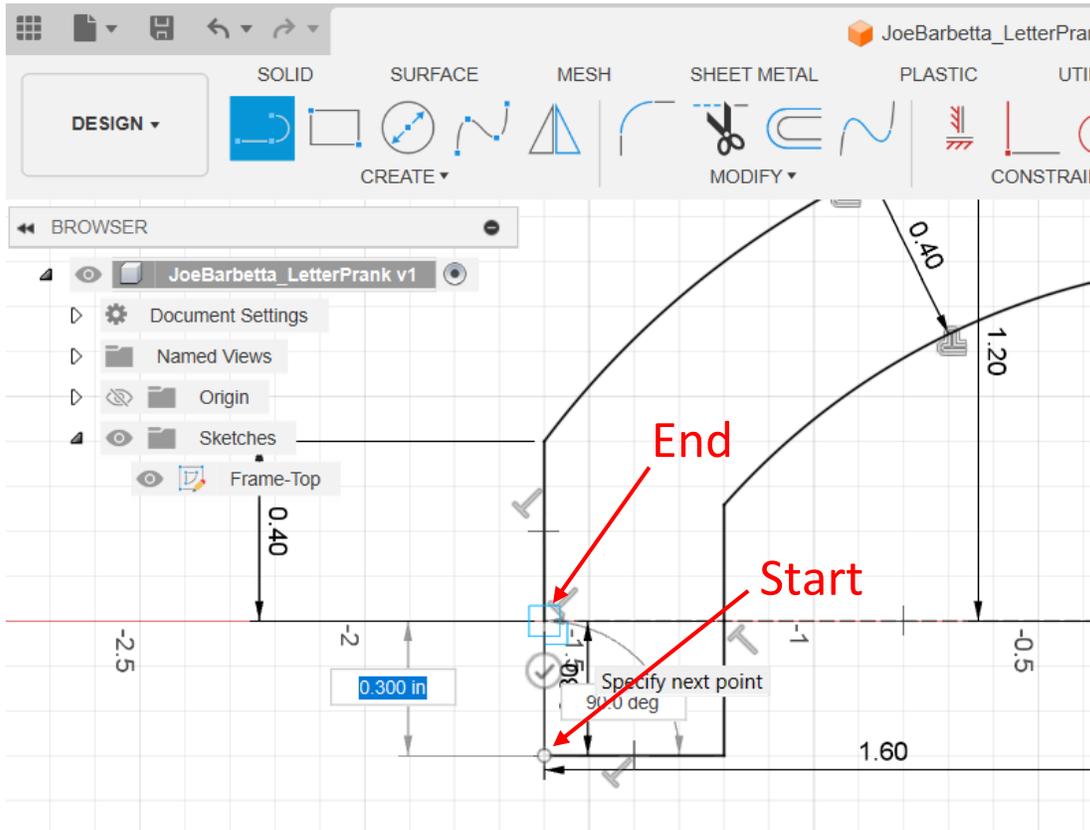
- select the **Offset** tool. If the icon is not there, select the tool from the **MODIFY** menu.
- click on the **arc**, ensure that **Chain Selection** is checked, and set **Offset to 0.4**. If the red line is not in the position shown, click on **Flip**. Click **OK**.



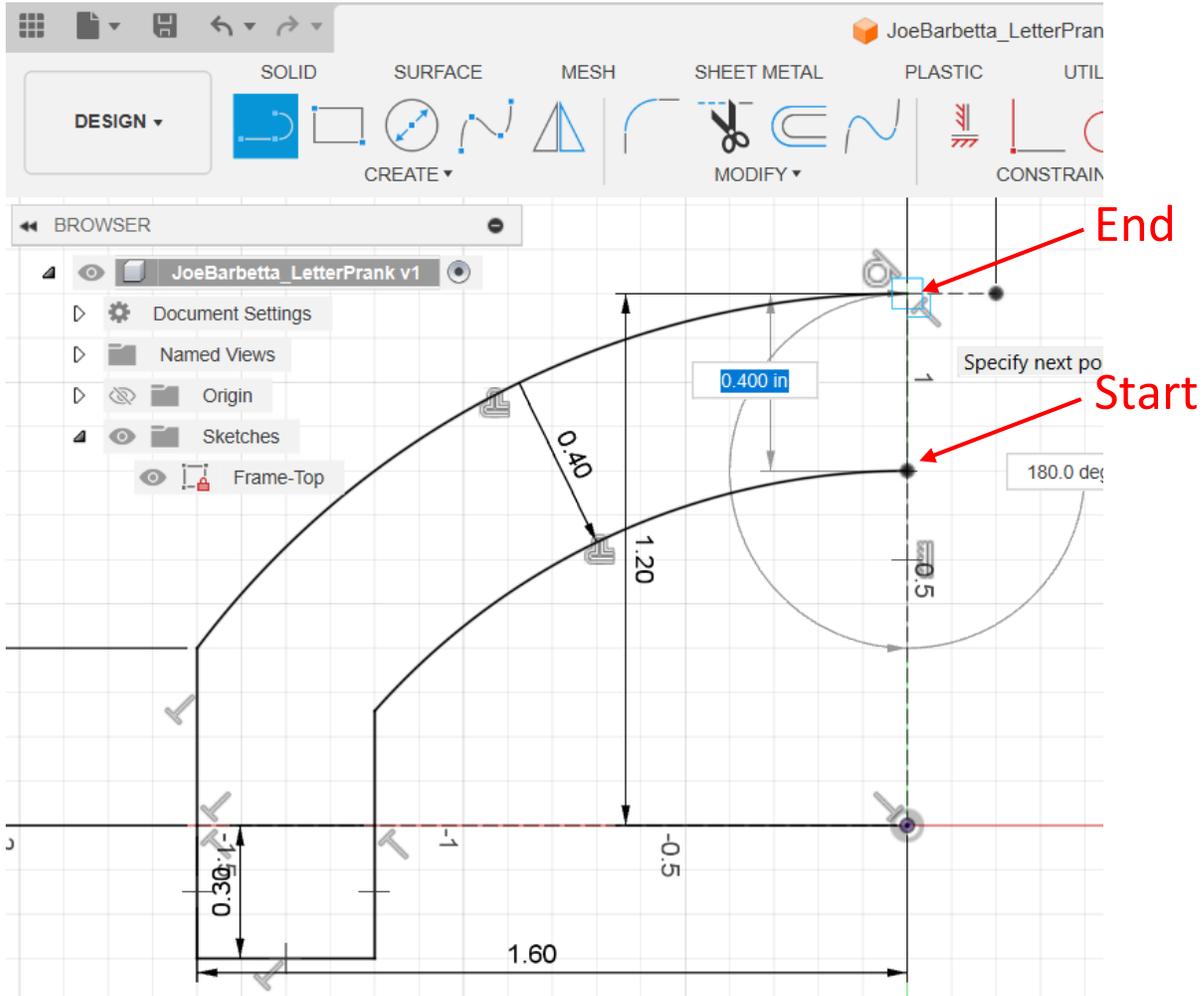
- zoom into the bottom as shown and use the Line tool to create a line starting at point A and down 0.3



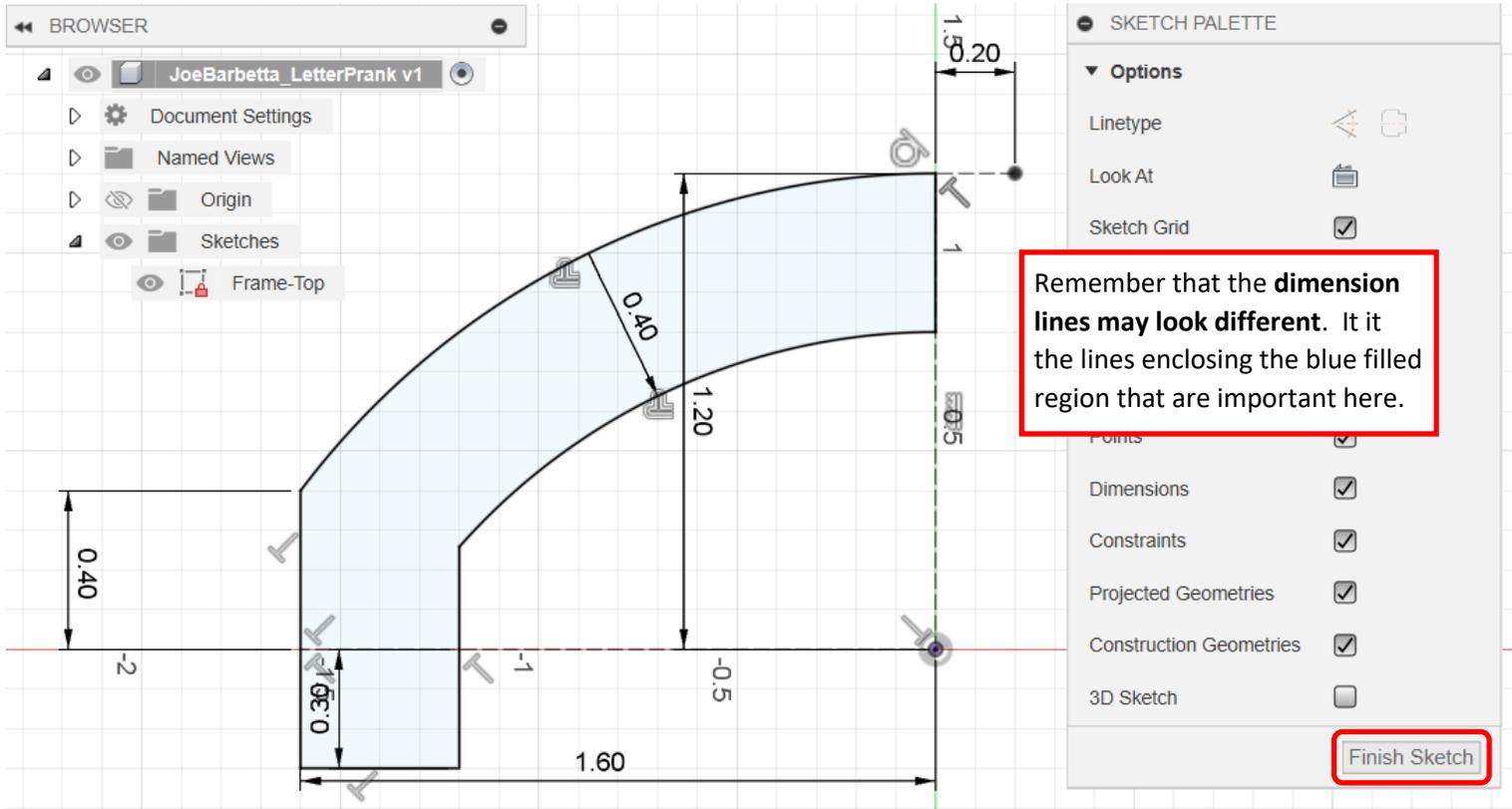
- create a line from the **Start** location to the left by **0.4** and then a line up to the **End** location.



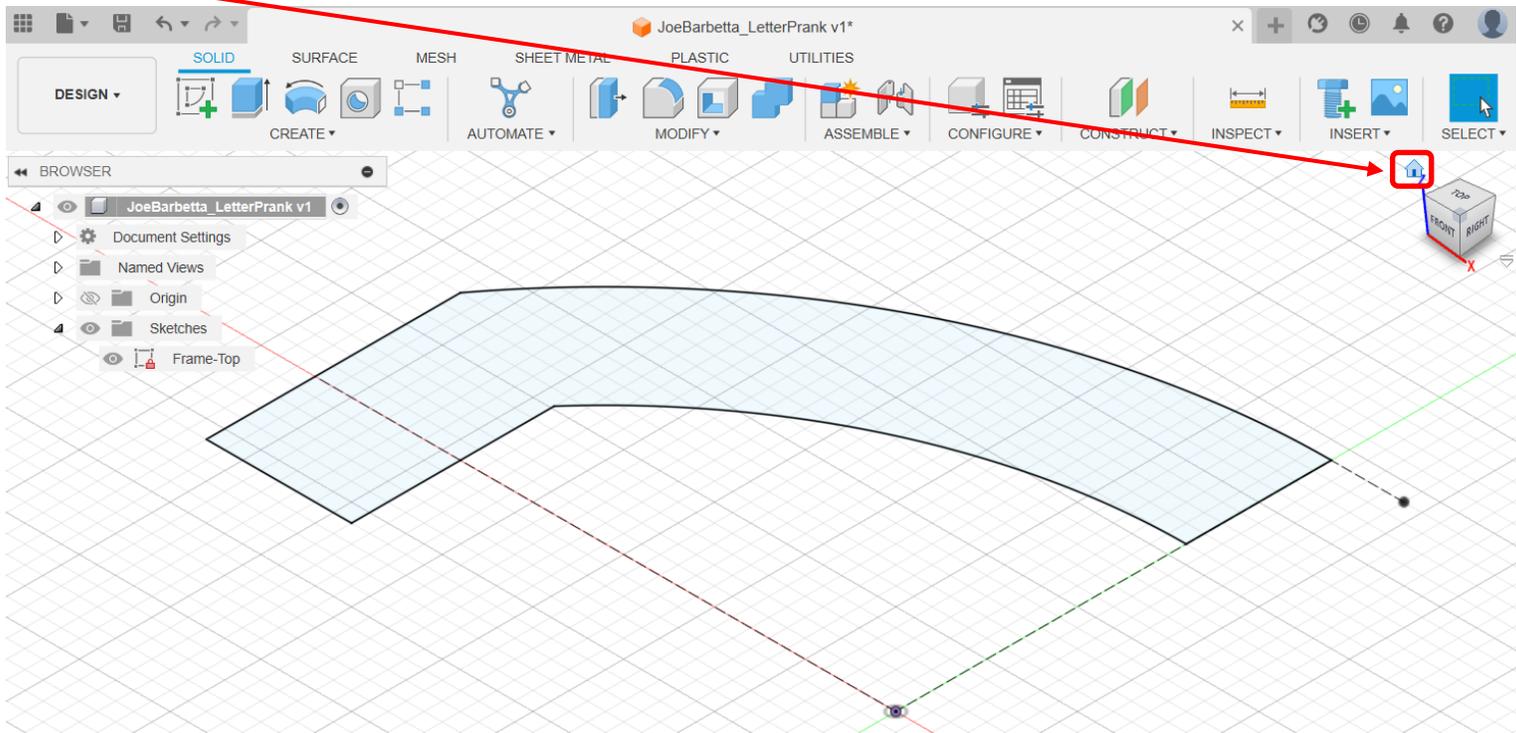
- pan (by holding down the mouse wheel) to the top right section and draw a line from **Start** to **End**.



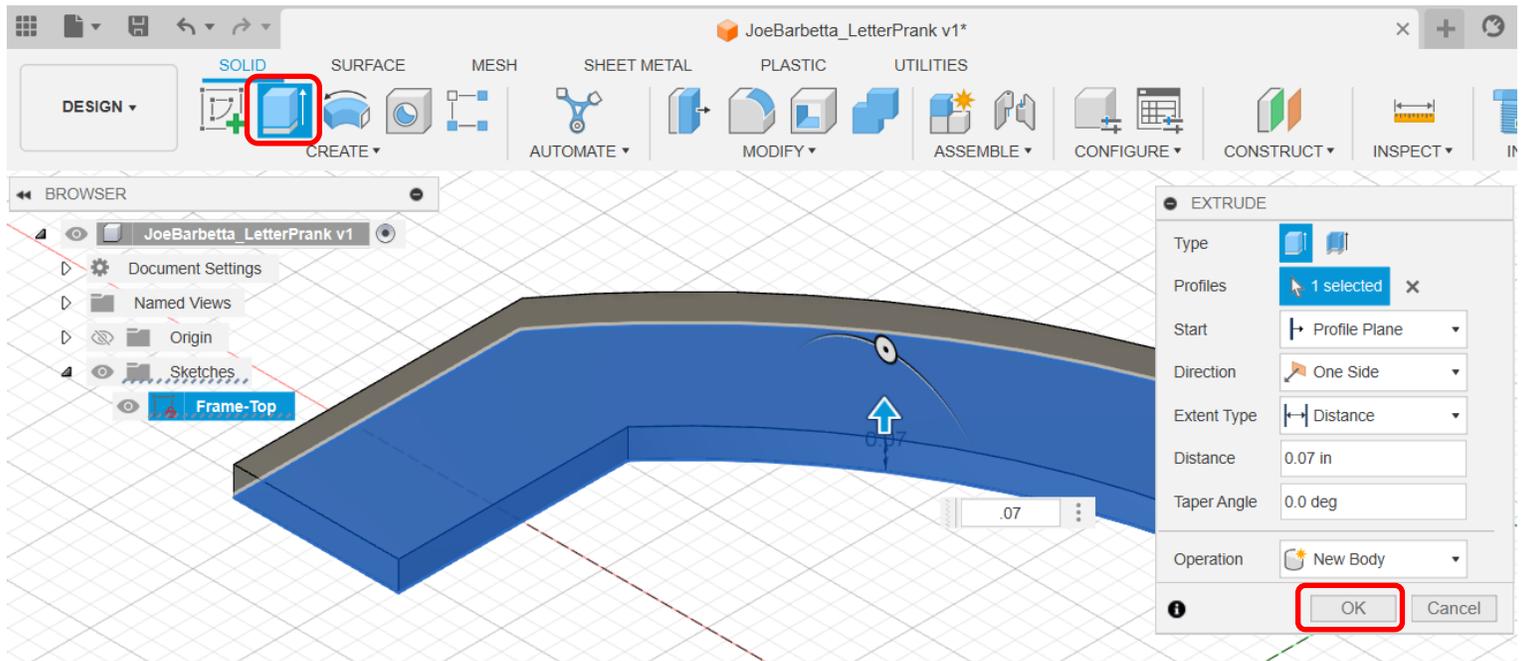
- the shape should now be filled with light blue. Click **Finish Sketch**.



- click on the **Home** icon at the **View Cube** to see this view.

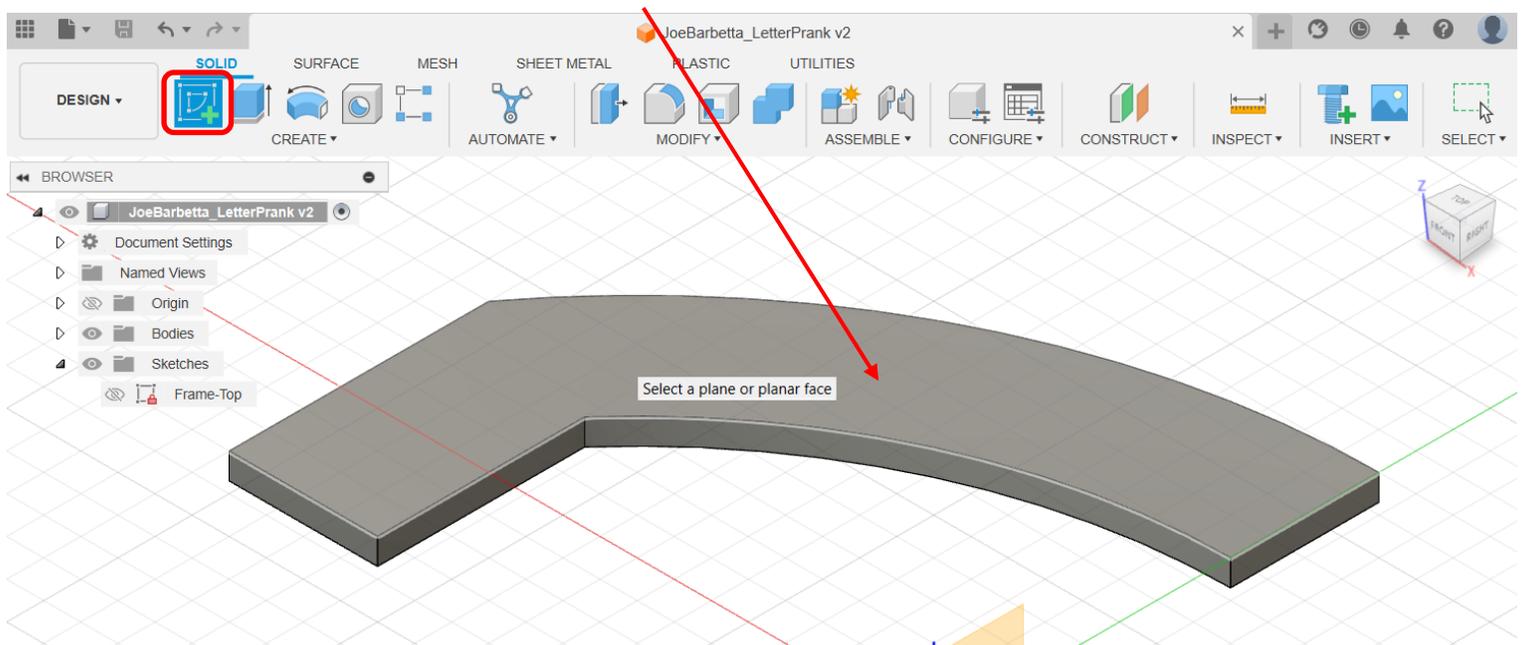


- select the **Extrude** tool, type **0.07**, and click **OK**.



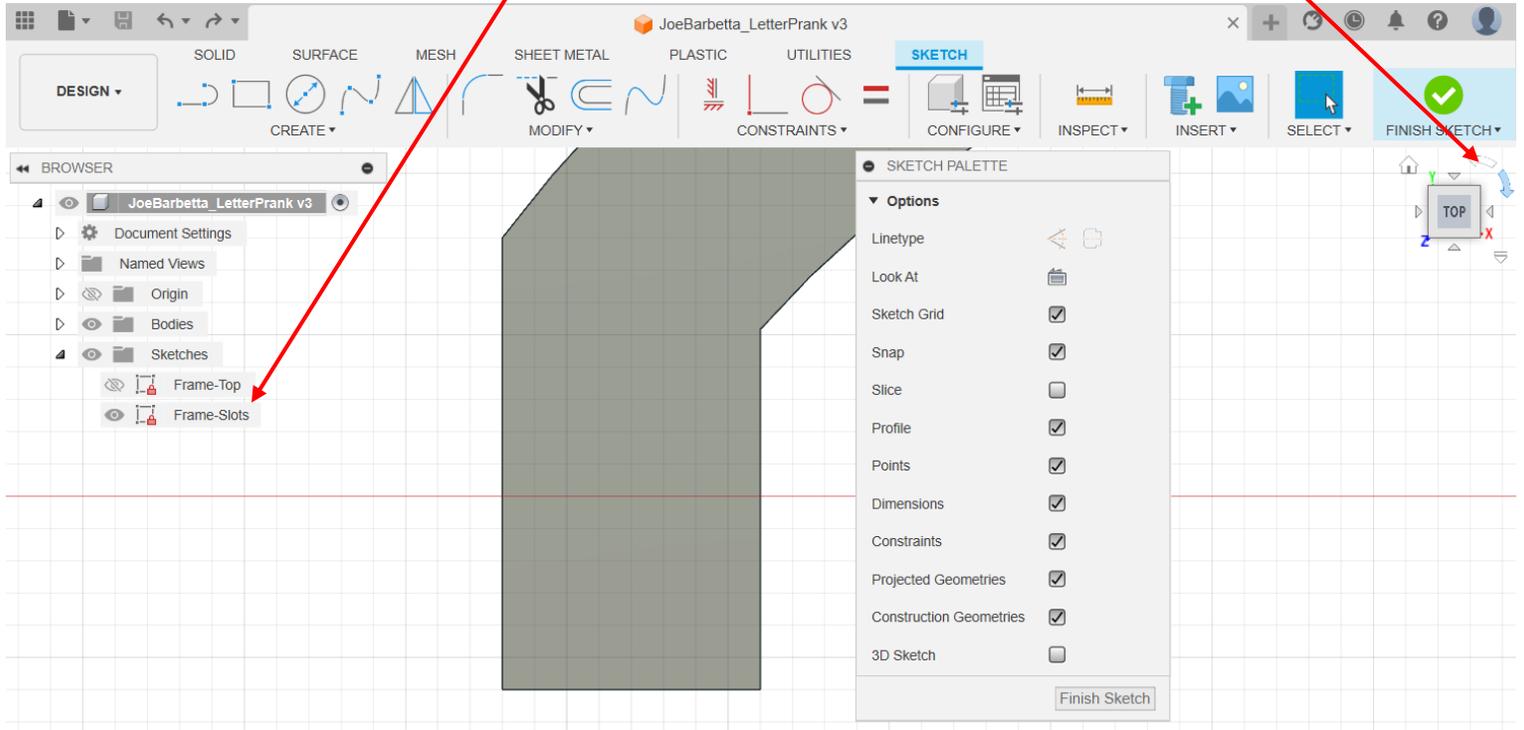
## Creating slots for the rubber band

- select the **Create Sketch** tool and click on the **top surface** of the body

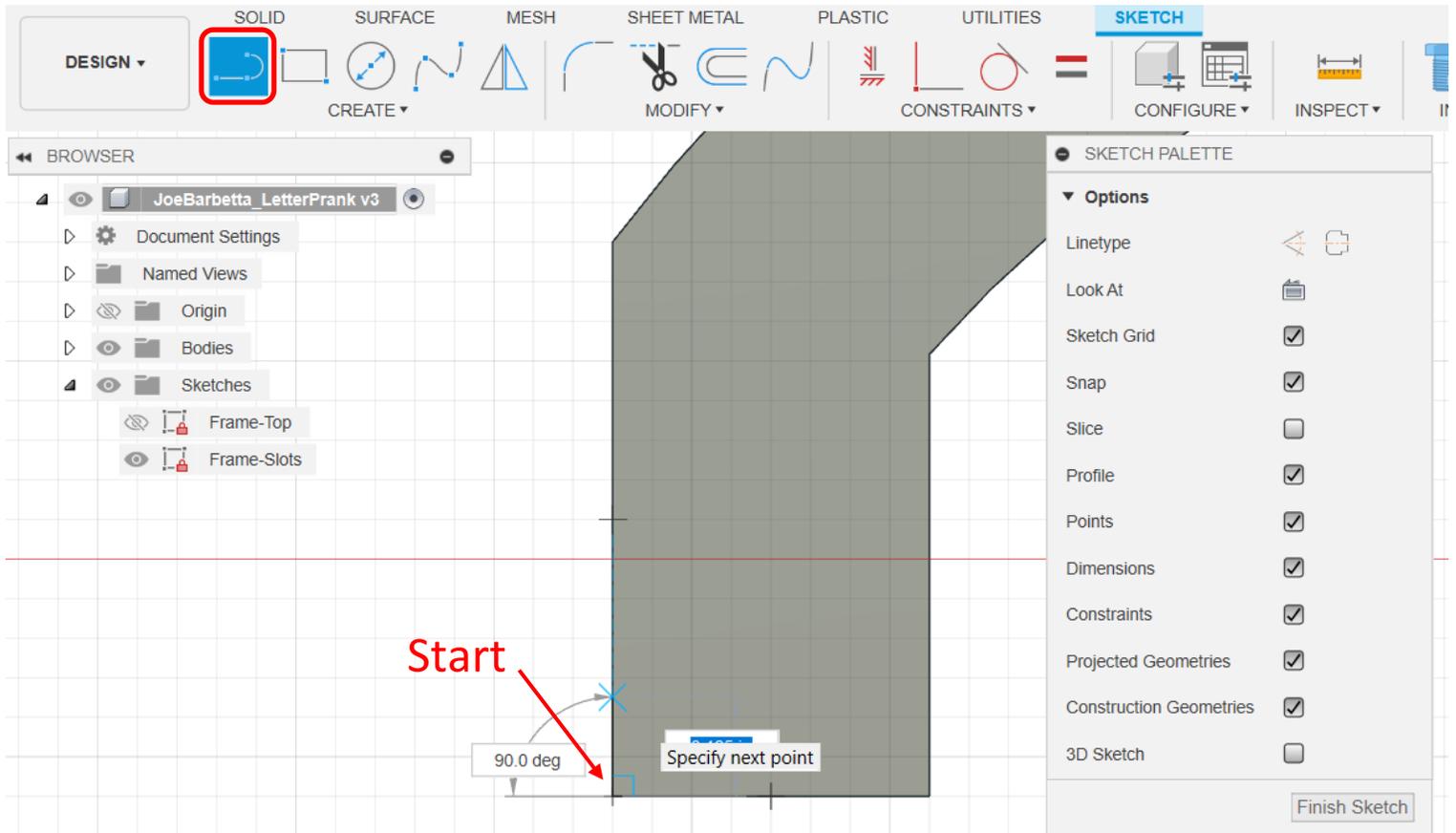


- rename the name of the new Sketch to **Frame-Slots**

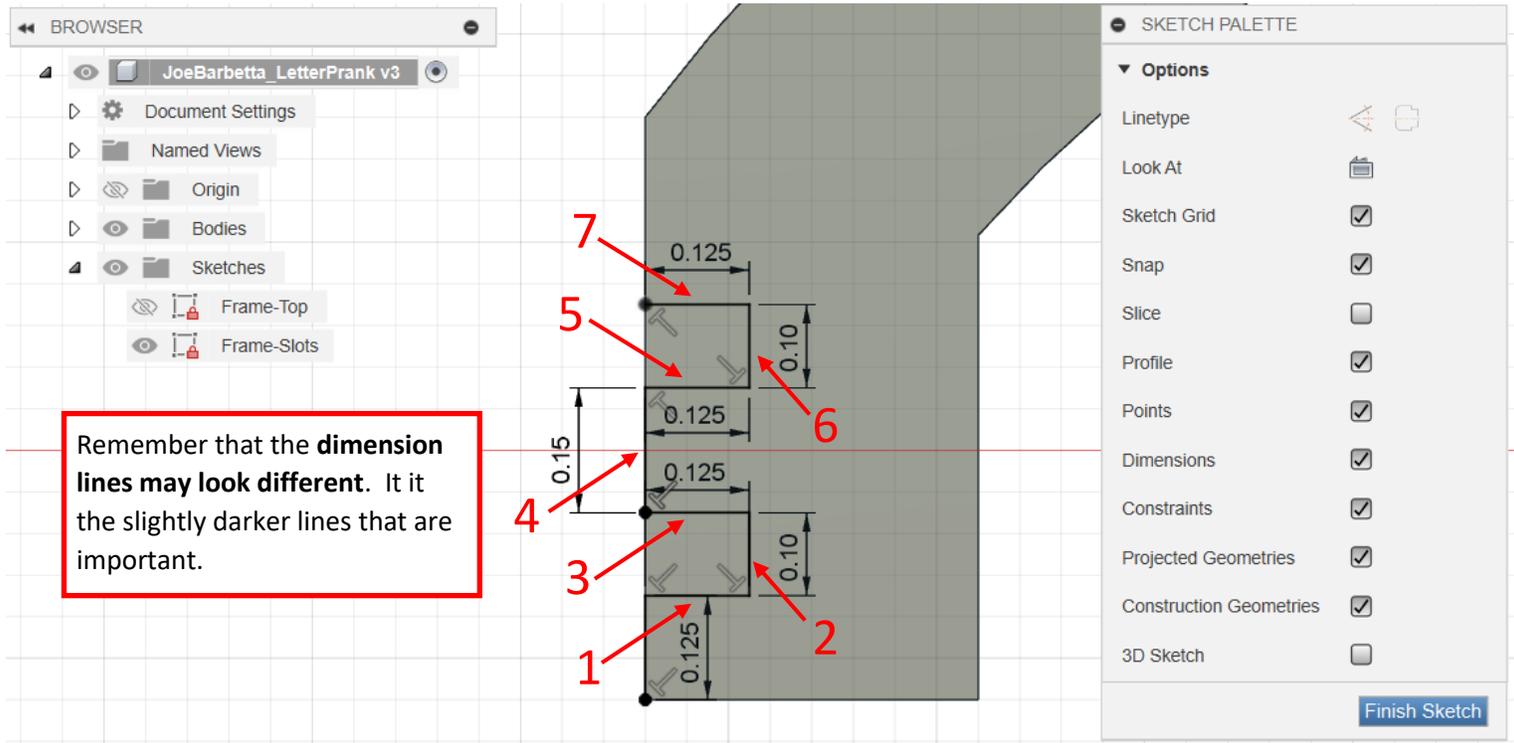
- **zoom** and **pan** to achieve a view similar to that below. If needed, a view can also be rotated using the curved arrows.



- select the **Line** tool and start the line at the **bottom left corner** and up by **0.125**



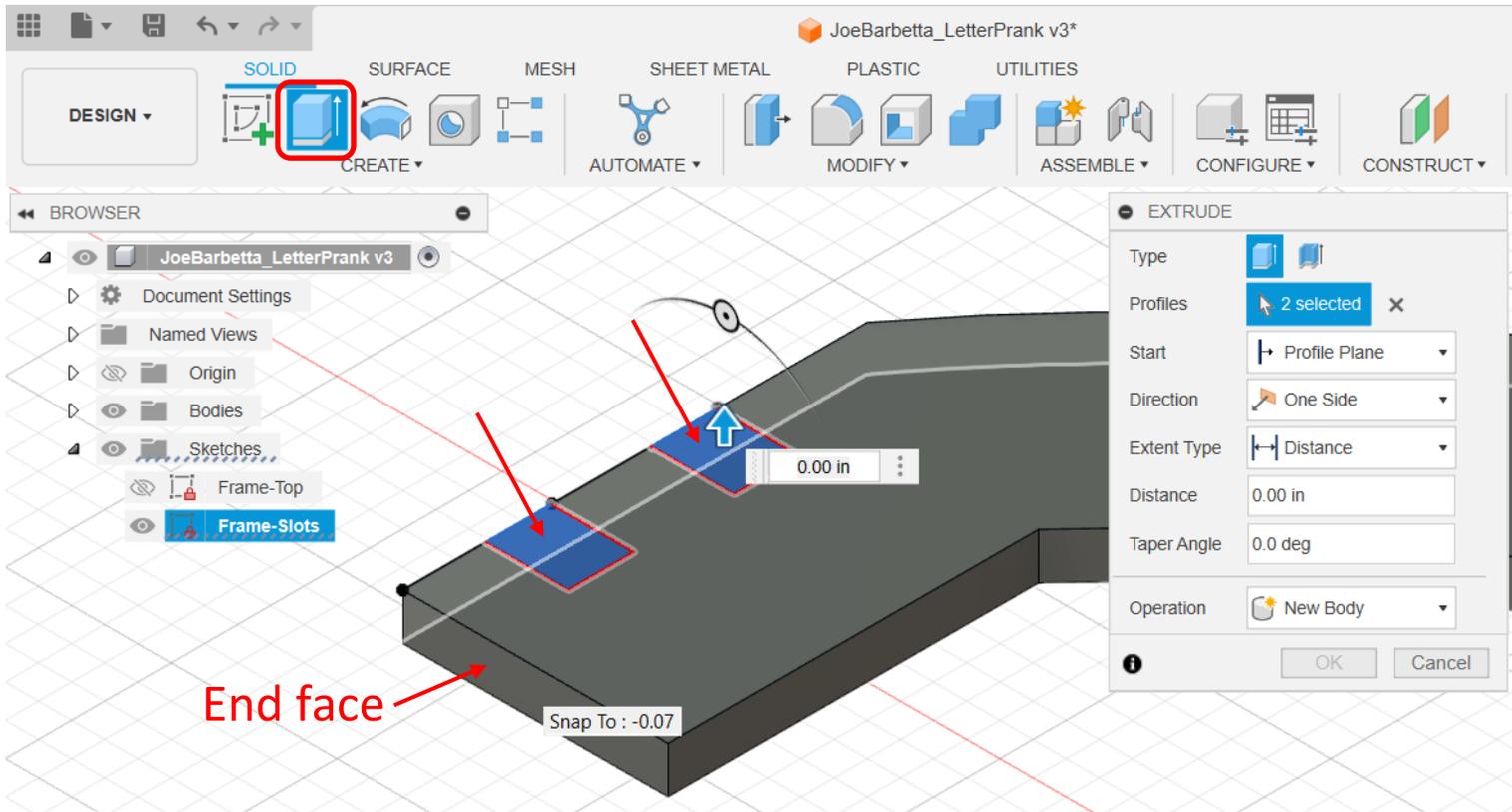
- continue creating the line segments numbered **1** to **7** using the **dimensions shown** for each line segment.



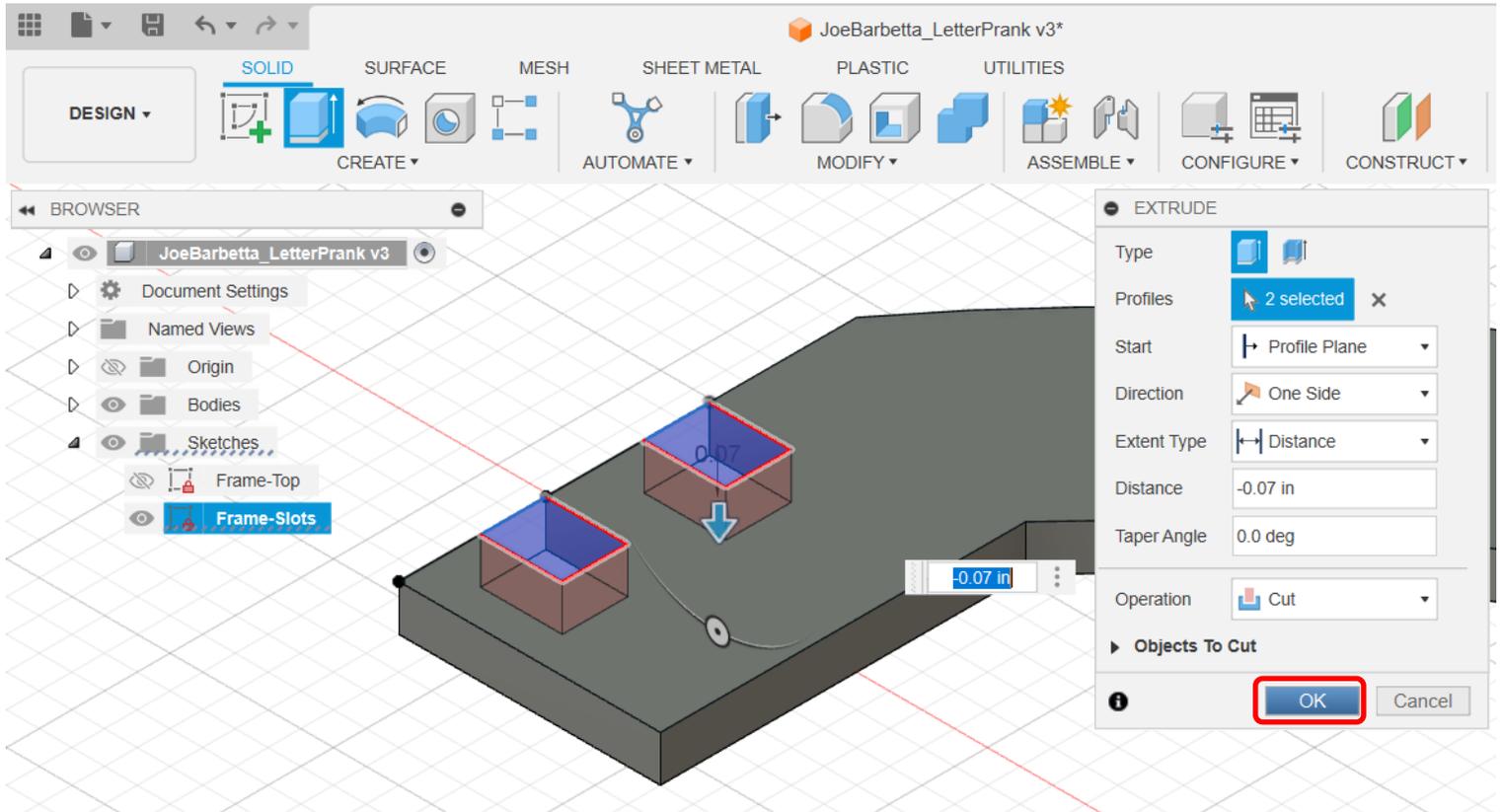
- go to the **Home** view

- select the **Extrude** tool and click on the **two regions** shown to turn them blue

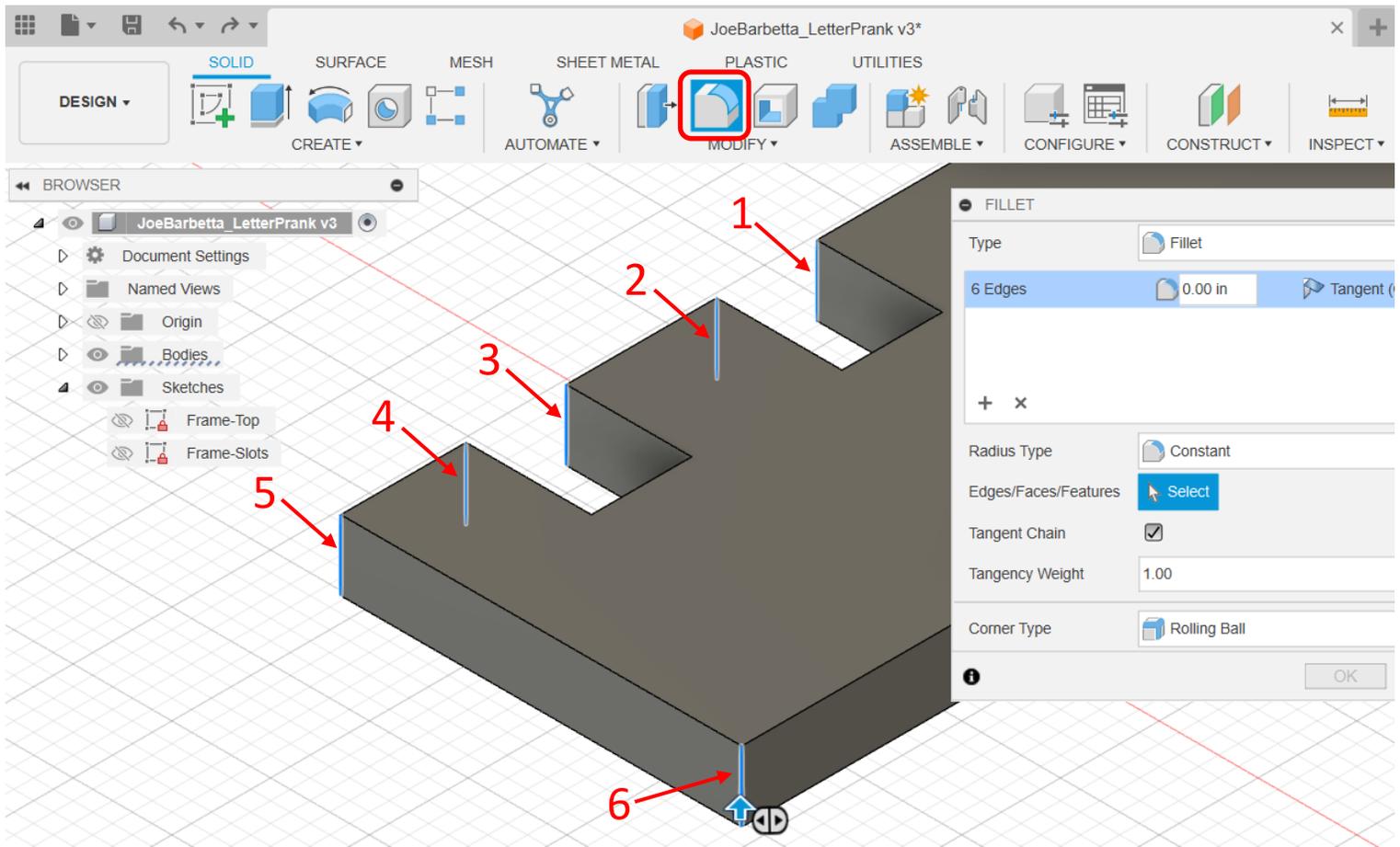
- click on the **end face**, which actually selects the bottom face to cause the blue rectangles to cut through the body



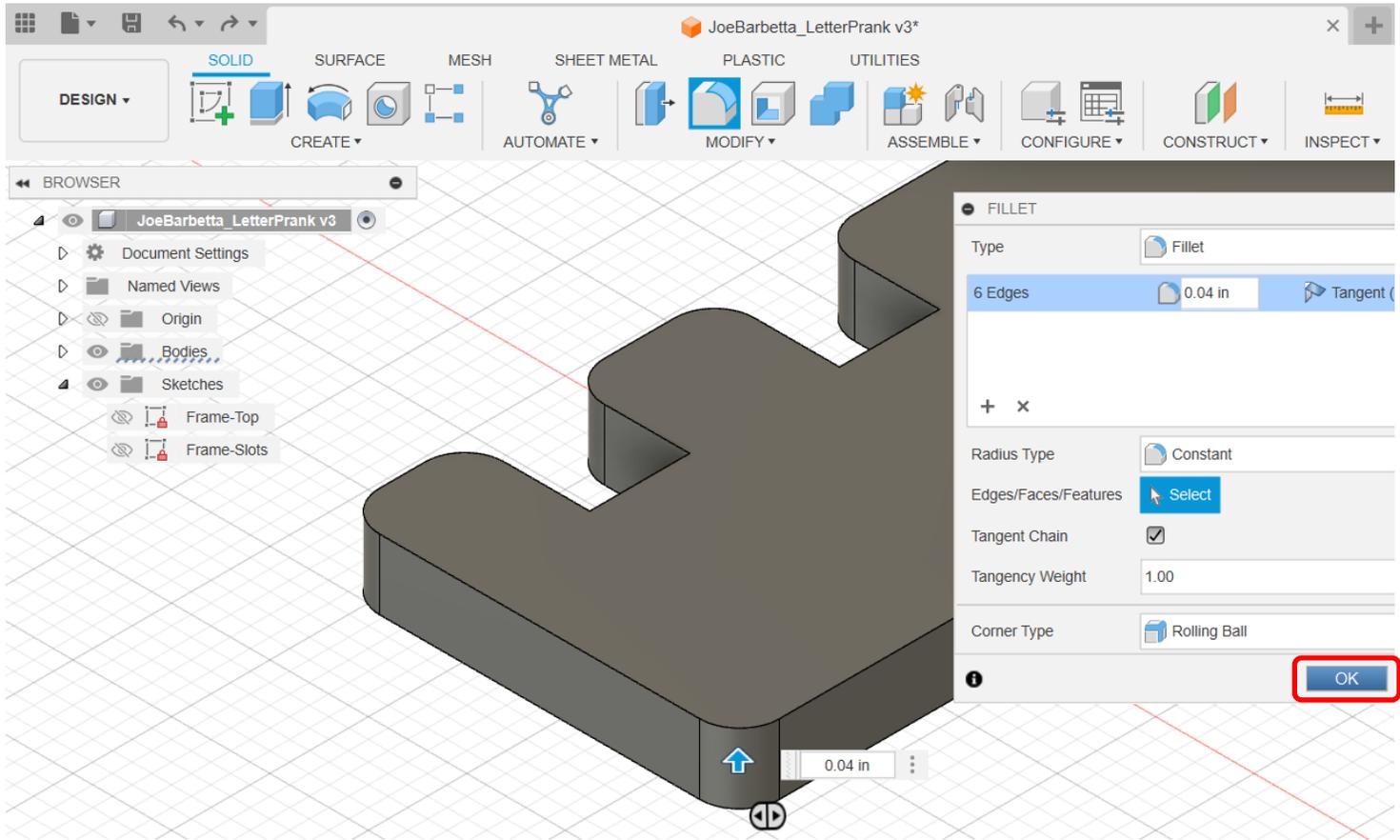
- click OK



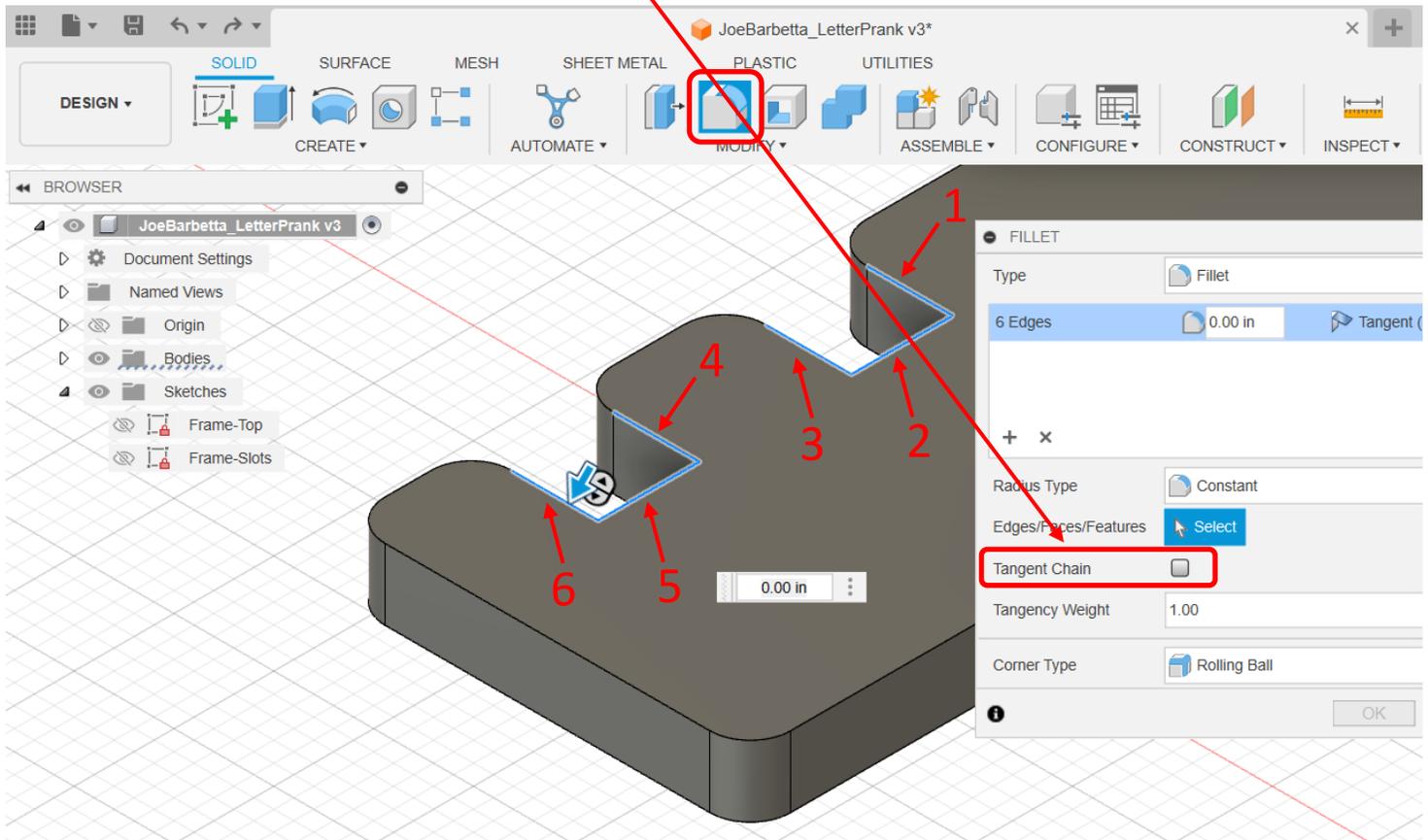
- select the **Fillet** tool and click on the **6 edges** shown. Note that for two, the edges are hidden and shown when you click on their location through the part.



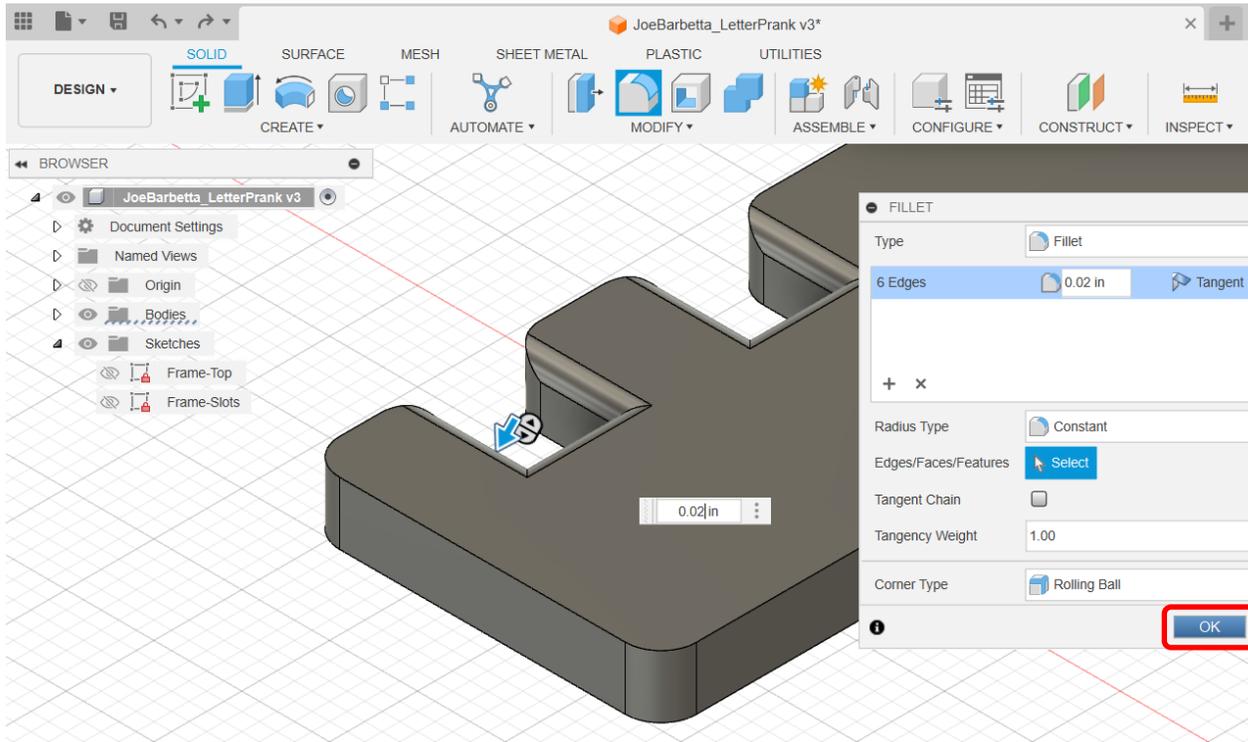
- type **0.04** and click **OK**



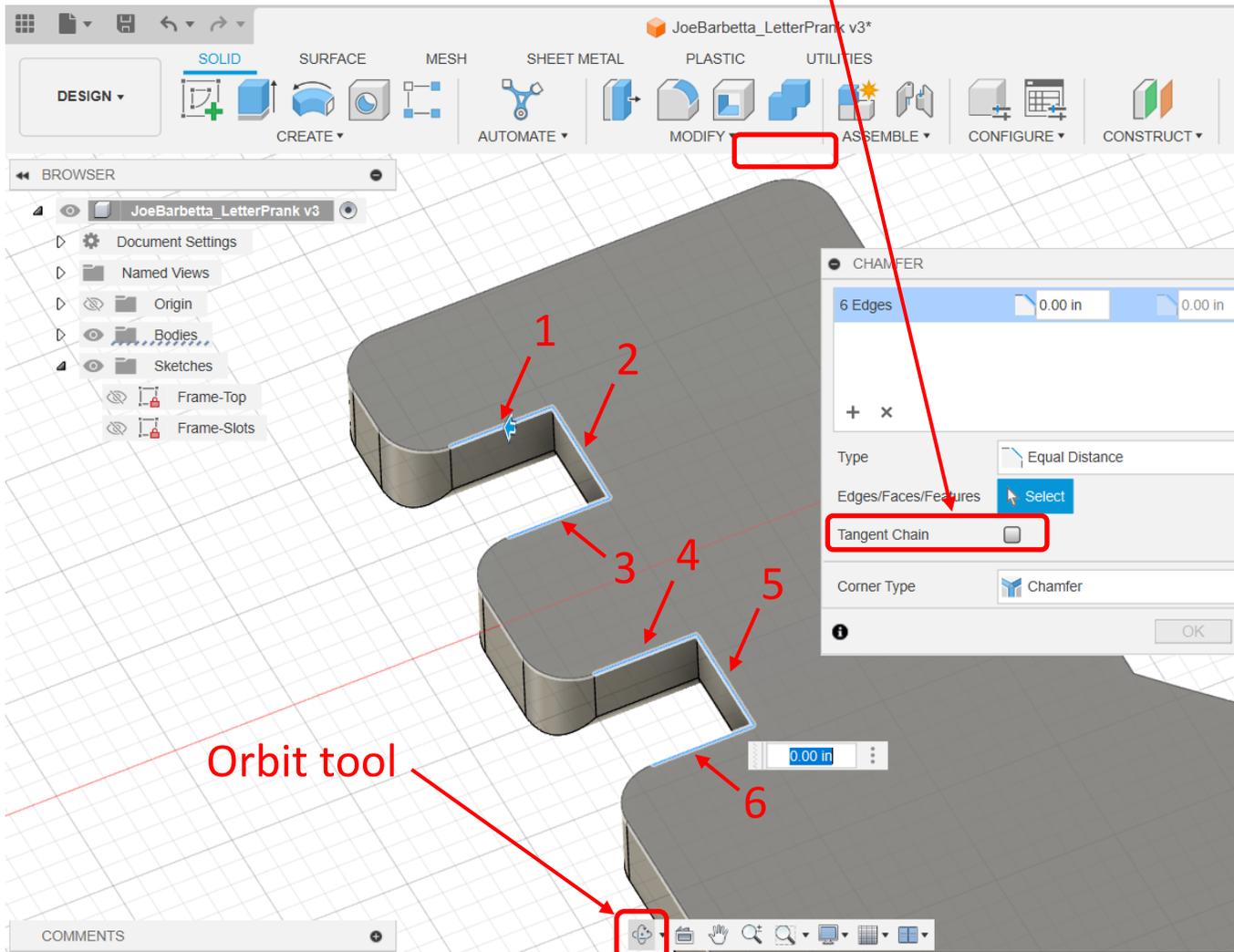
- select the **Fillet** tool again and ensure that **Tangent Chain** is **unchecked**  
- click on the **6 edges** as shown



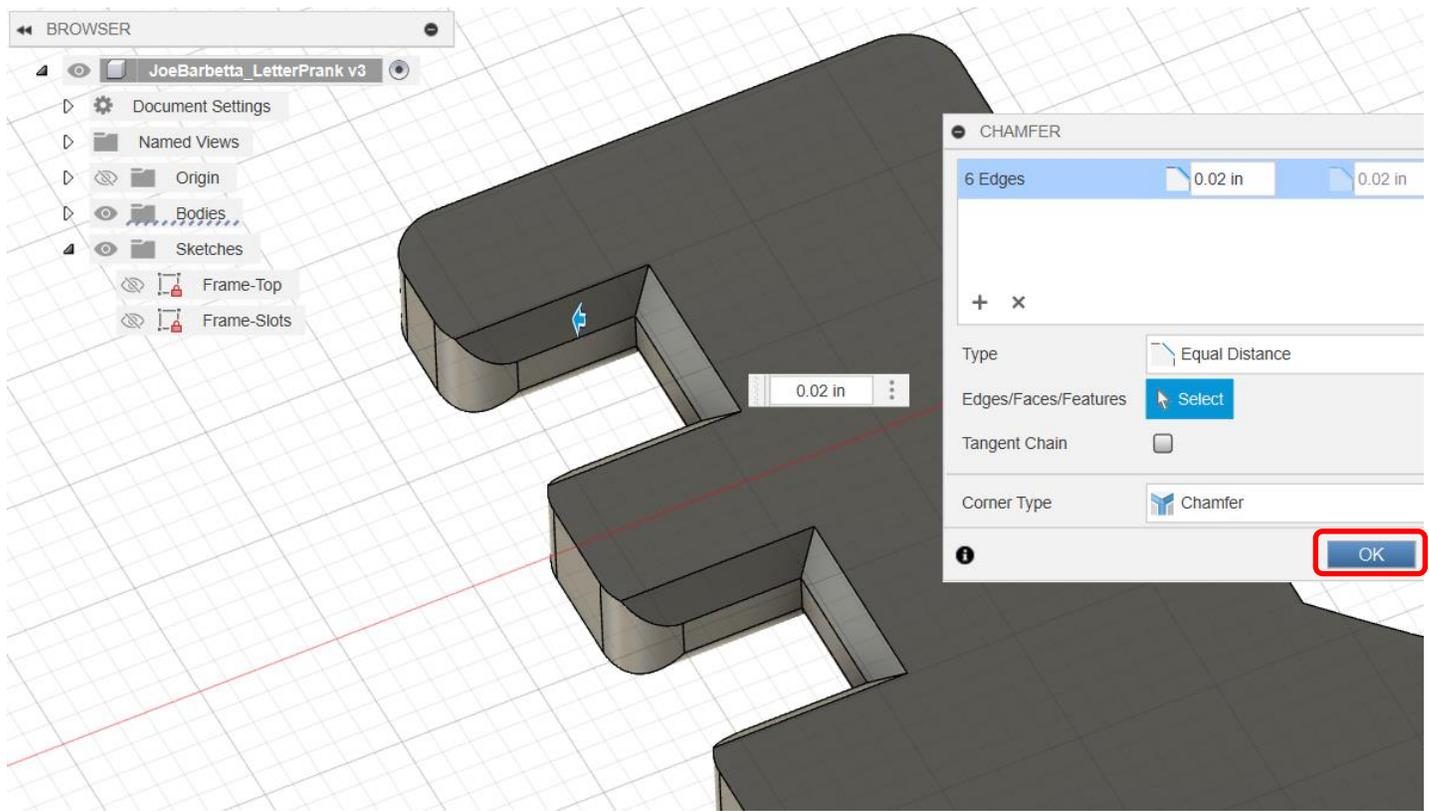
- type **0.02** and click **OK**



- select the bottom **Orbit** tool and click on the body to rotate the view to access the **underside of the body** as shown
- select the **Chamfer** tool in the **MODIFY** menu and ensure that **Tangent Chain** is unchecked.
- click on the **6 edges** as shown

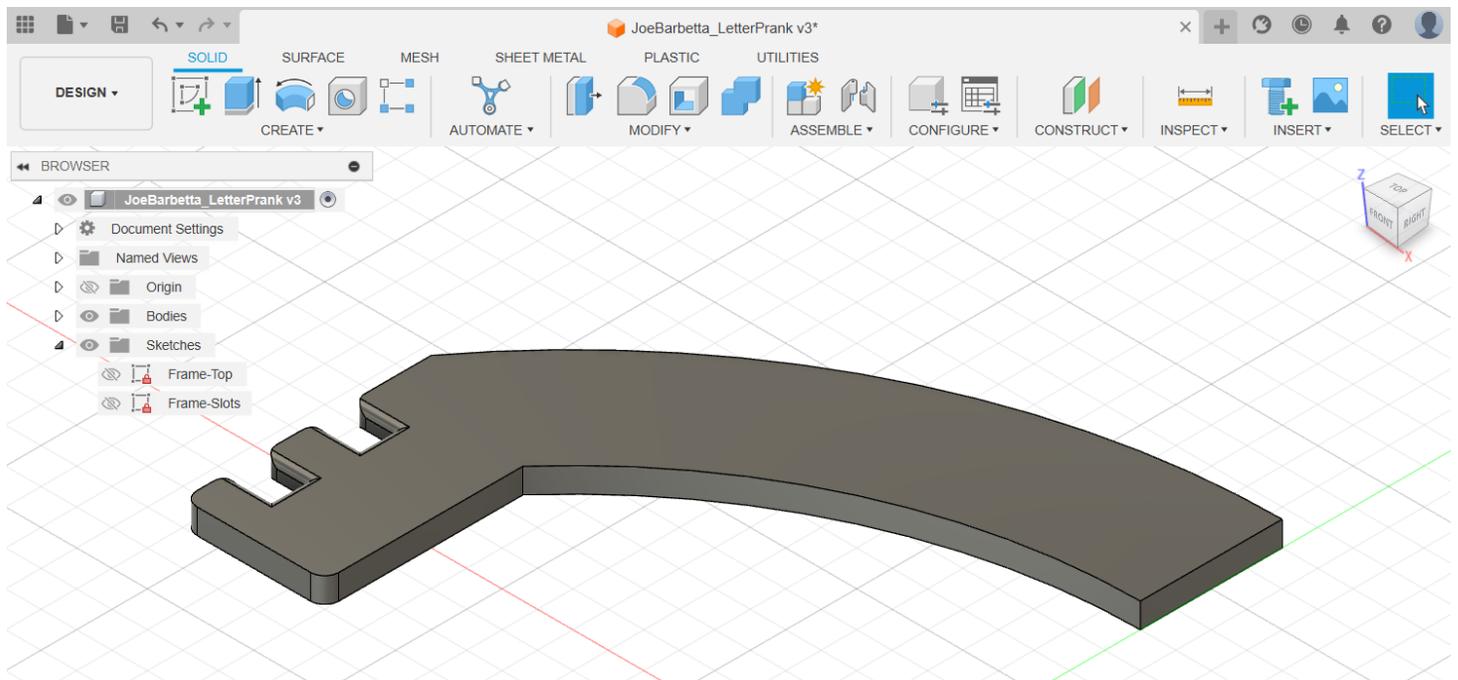


- type **0.02** and click **OK**



The purpose of the Fillets and Chamfers was to smooth the edges that the rubber band will wrap around.

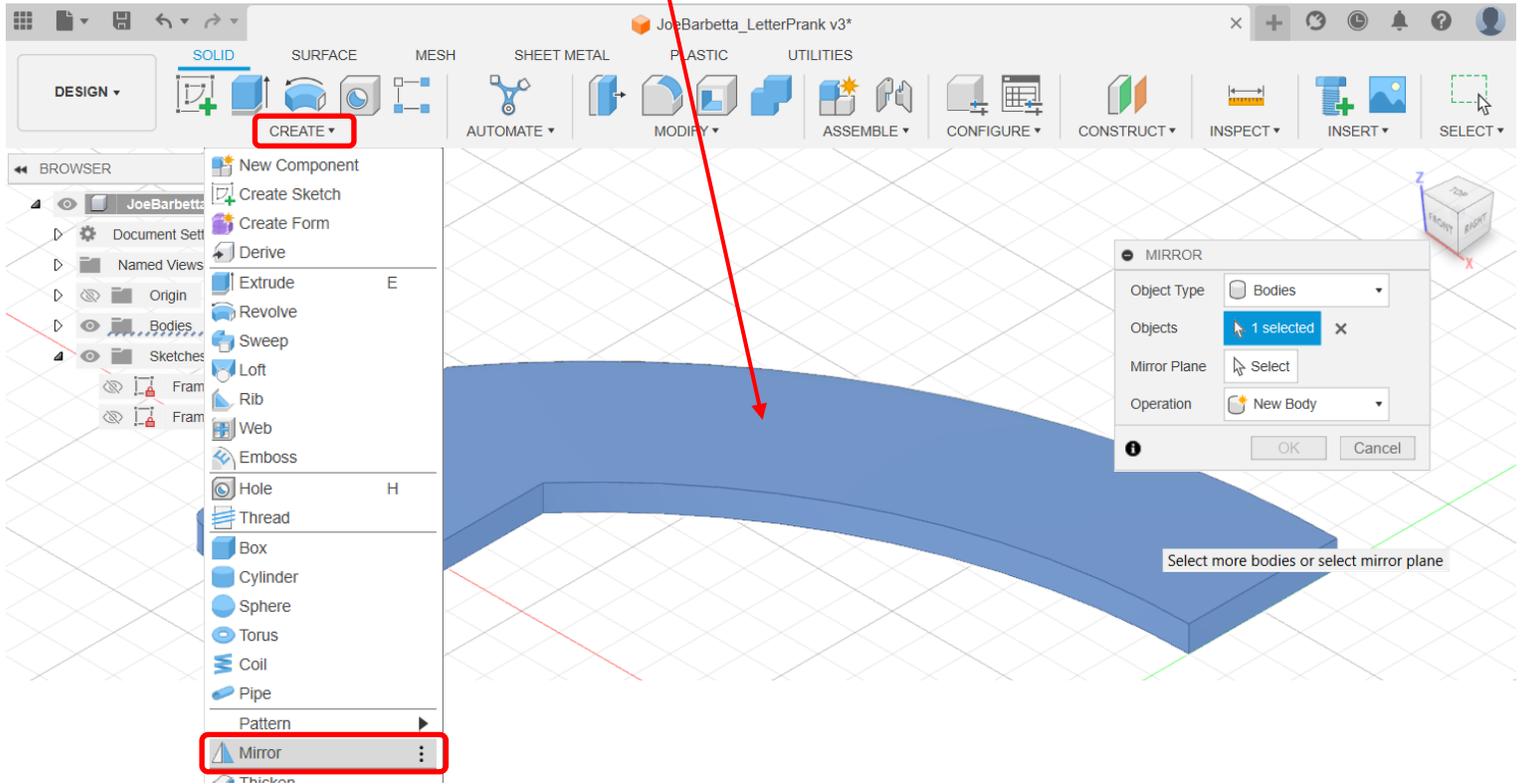
- return to the **Home** view



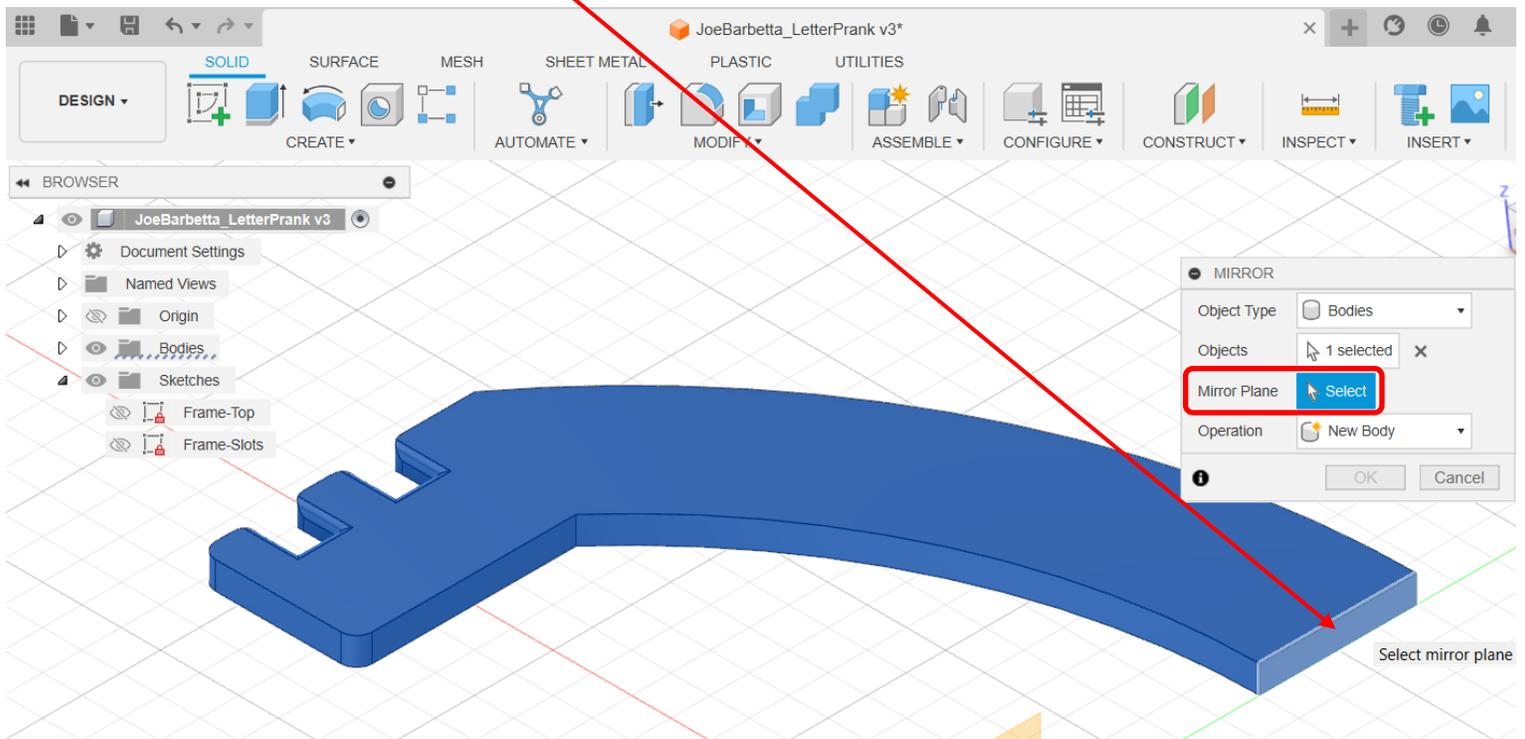
## Mirroring the Body

It is a common strategy for symmetrical objects to design on half and then use a **mirror operation**.

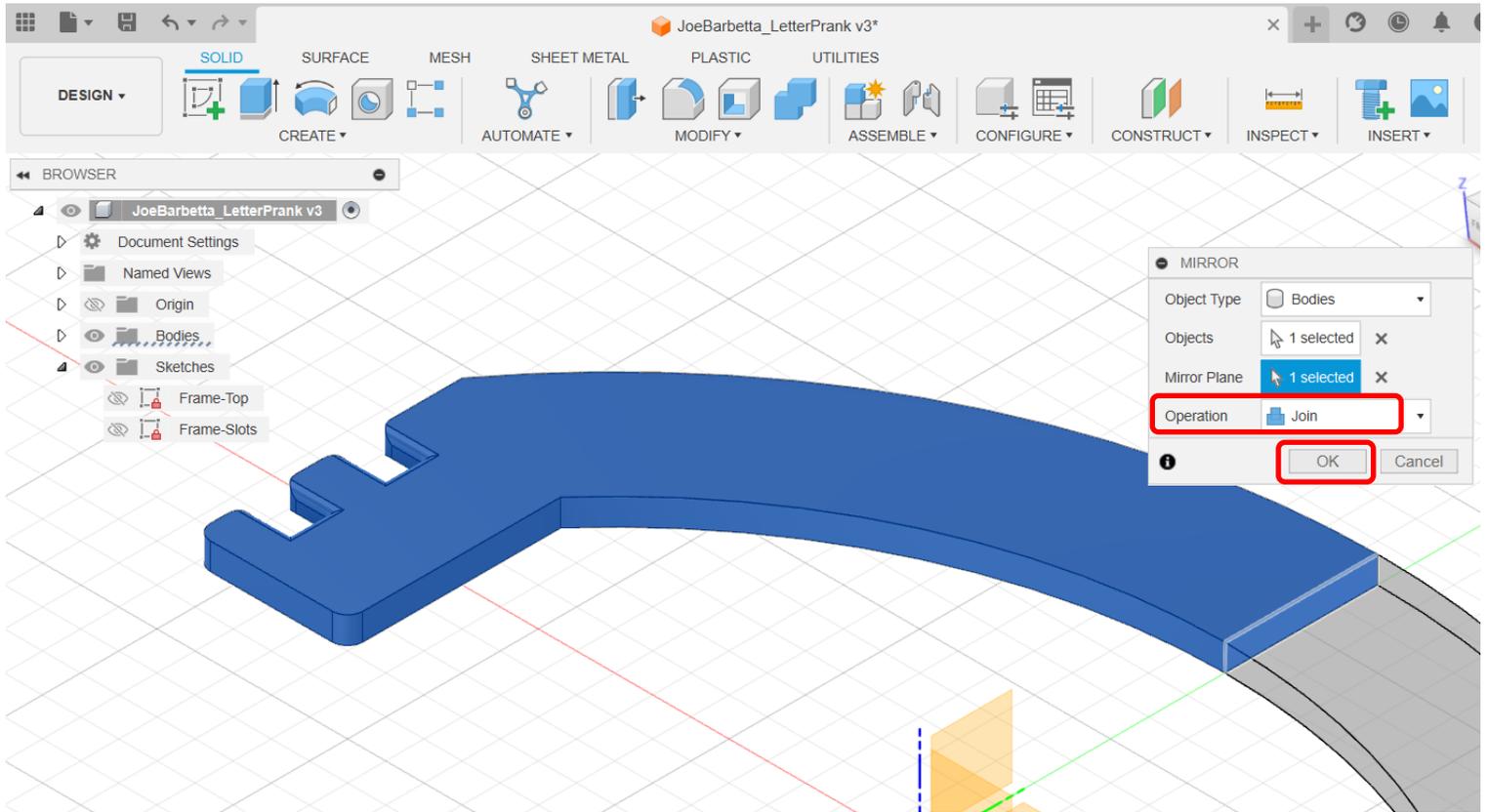
- select the **Mirror** tool in the **CREATE** menu and **click on the body**



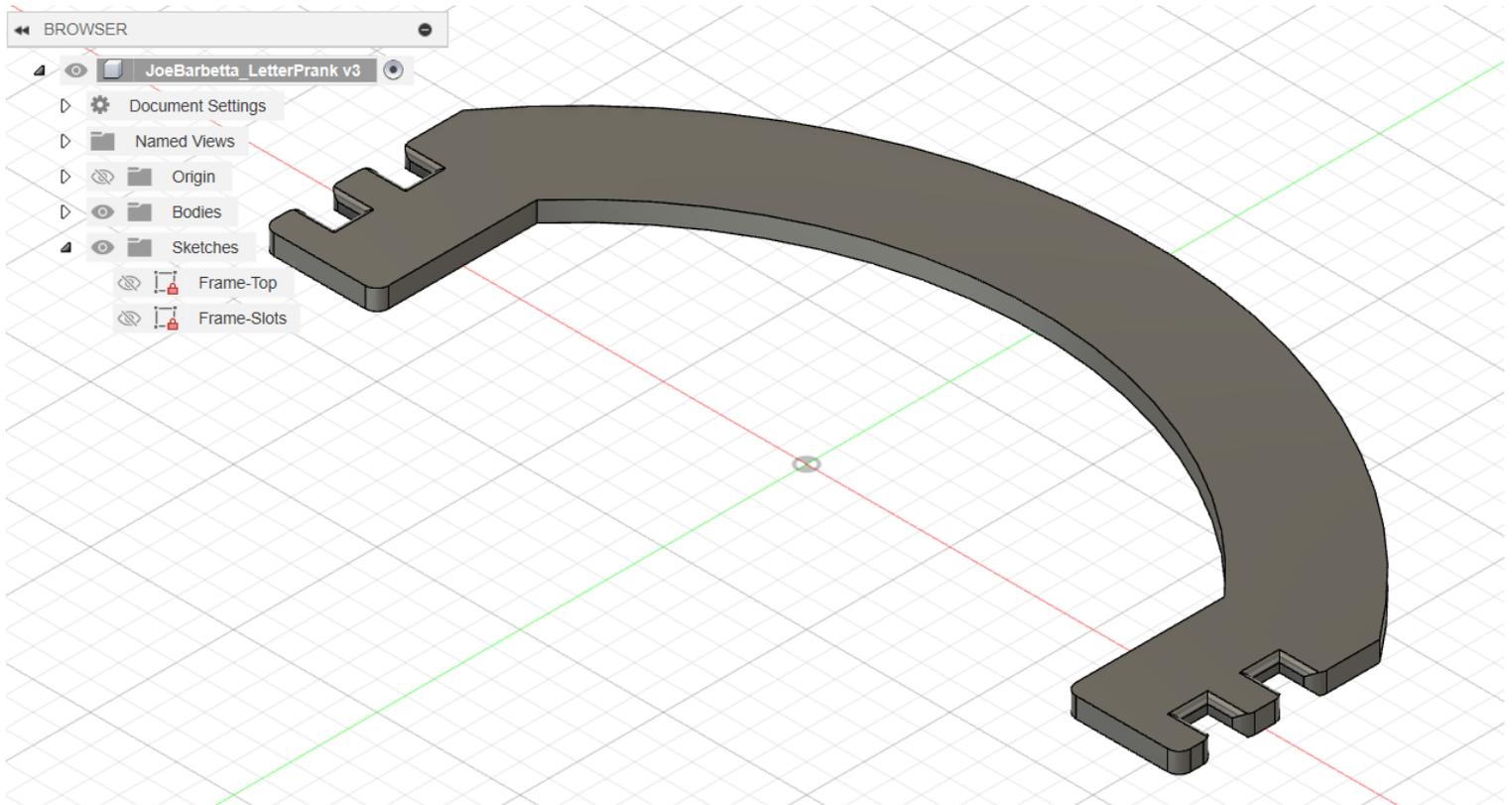
- select **Mirror Plane** and then click on the **end face** of the body



- ensure the **Operation** is **Join** and then click **OK**

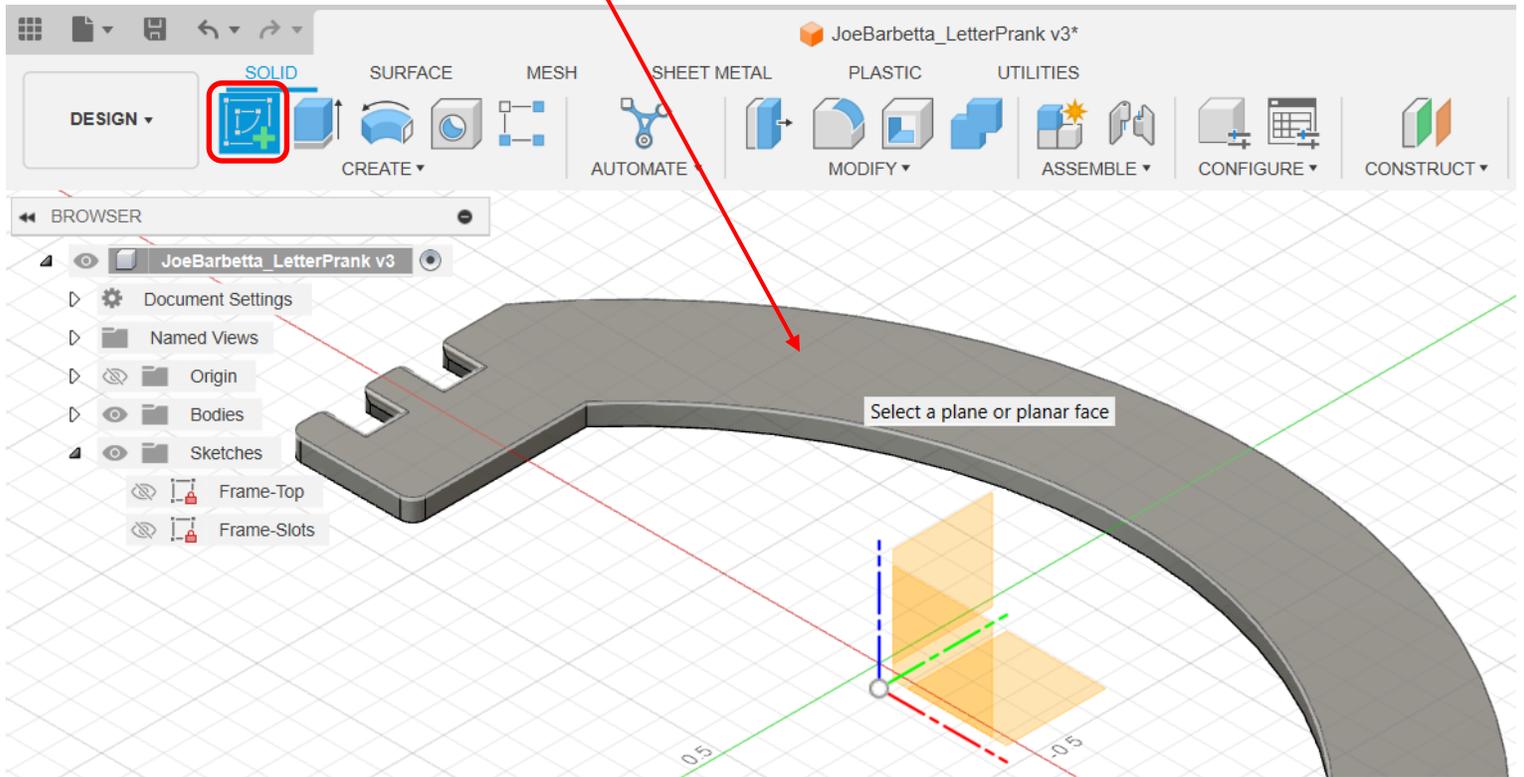


- the **Home** view should now look as below

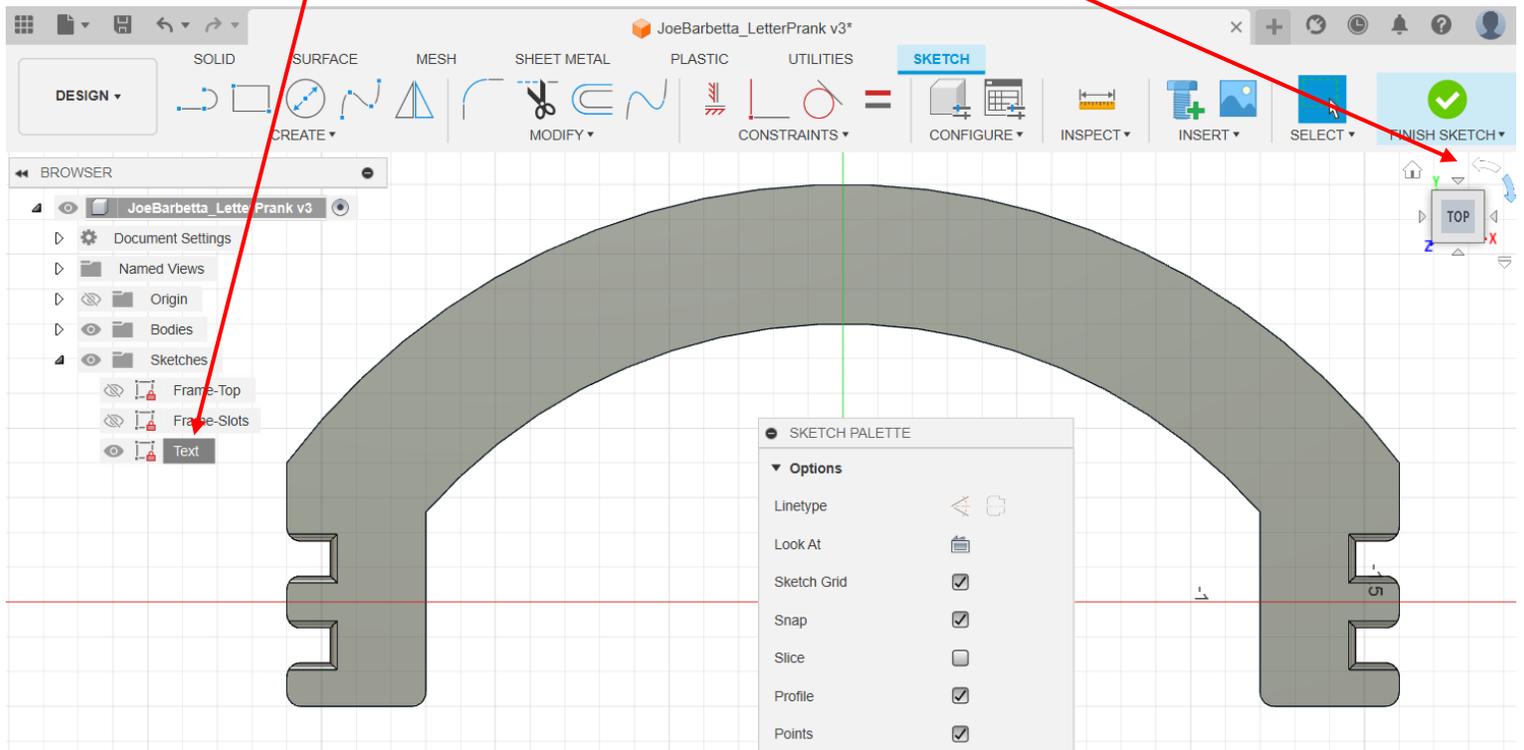


## Adding Text on a Path

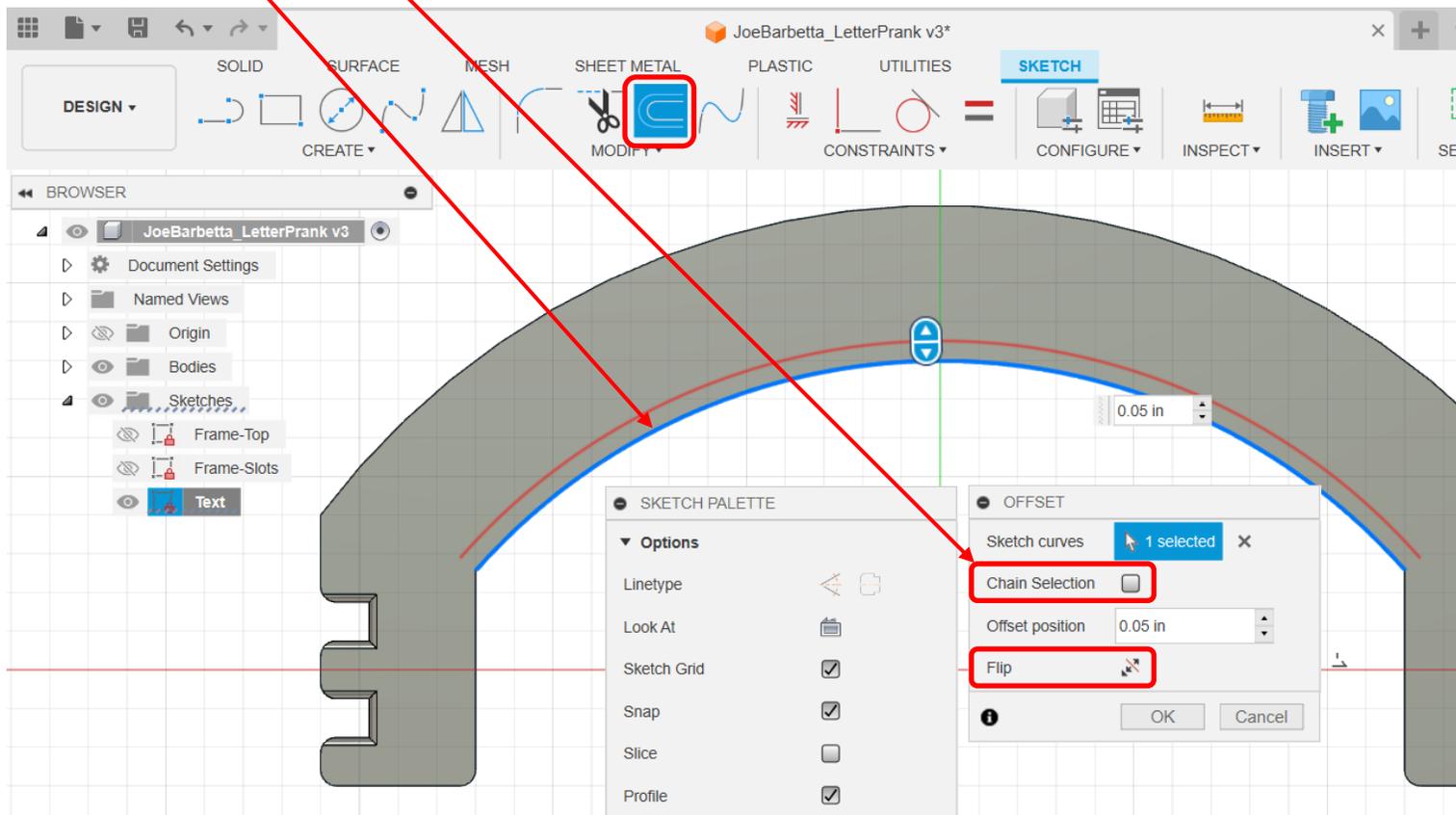
- select the **Create Sketch** tool and click on the **top face**



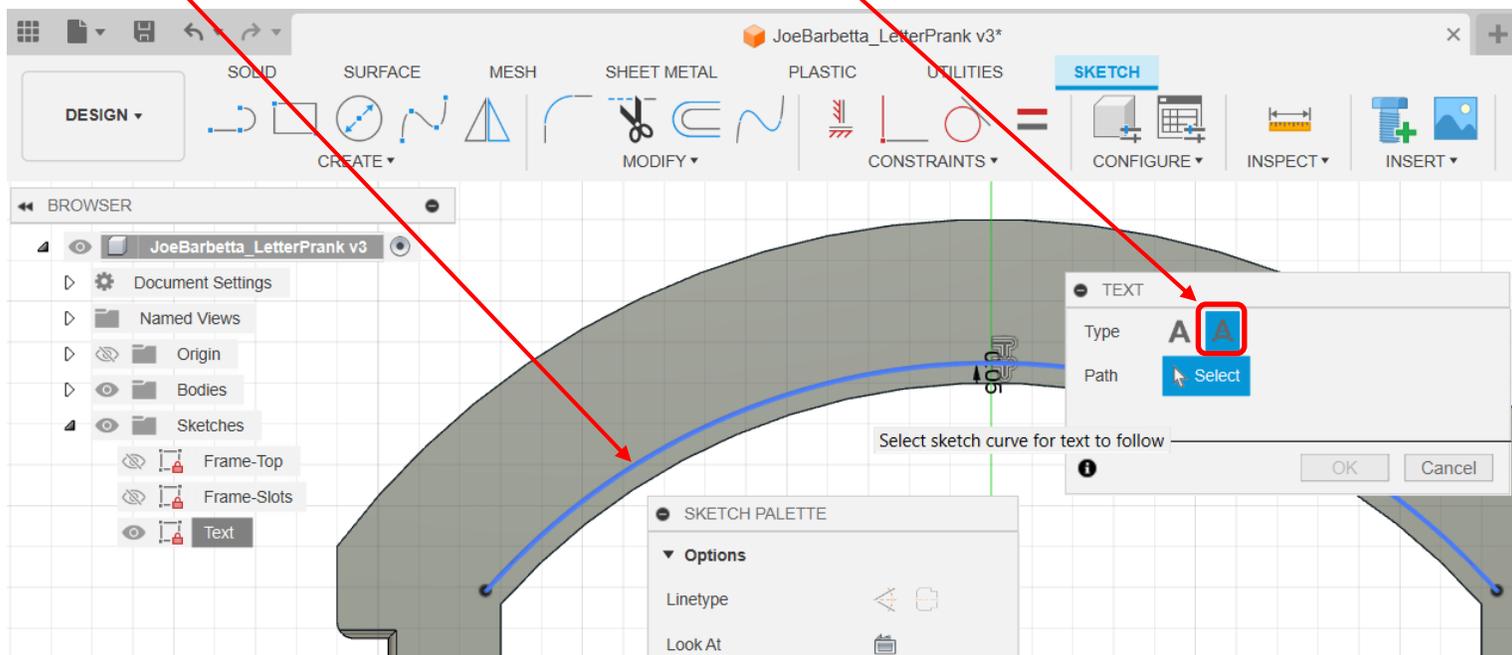
- use **Zoom** and **Pan** to set the view similar to that below. If needed the **curved arrows** will rotate a view.
- rename the **Sketch** to **Text**



- select the **Offset** tool. If the icon isn't there the tool can be found in the **MODIFY** menu
- ensure that **Chain Selection** is unchecked
- click on the **lower arc** and type **0.05**. If the new red arc is Not above the blue arc, click on the **Flip** icon.
- click **OK**

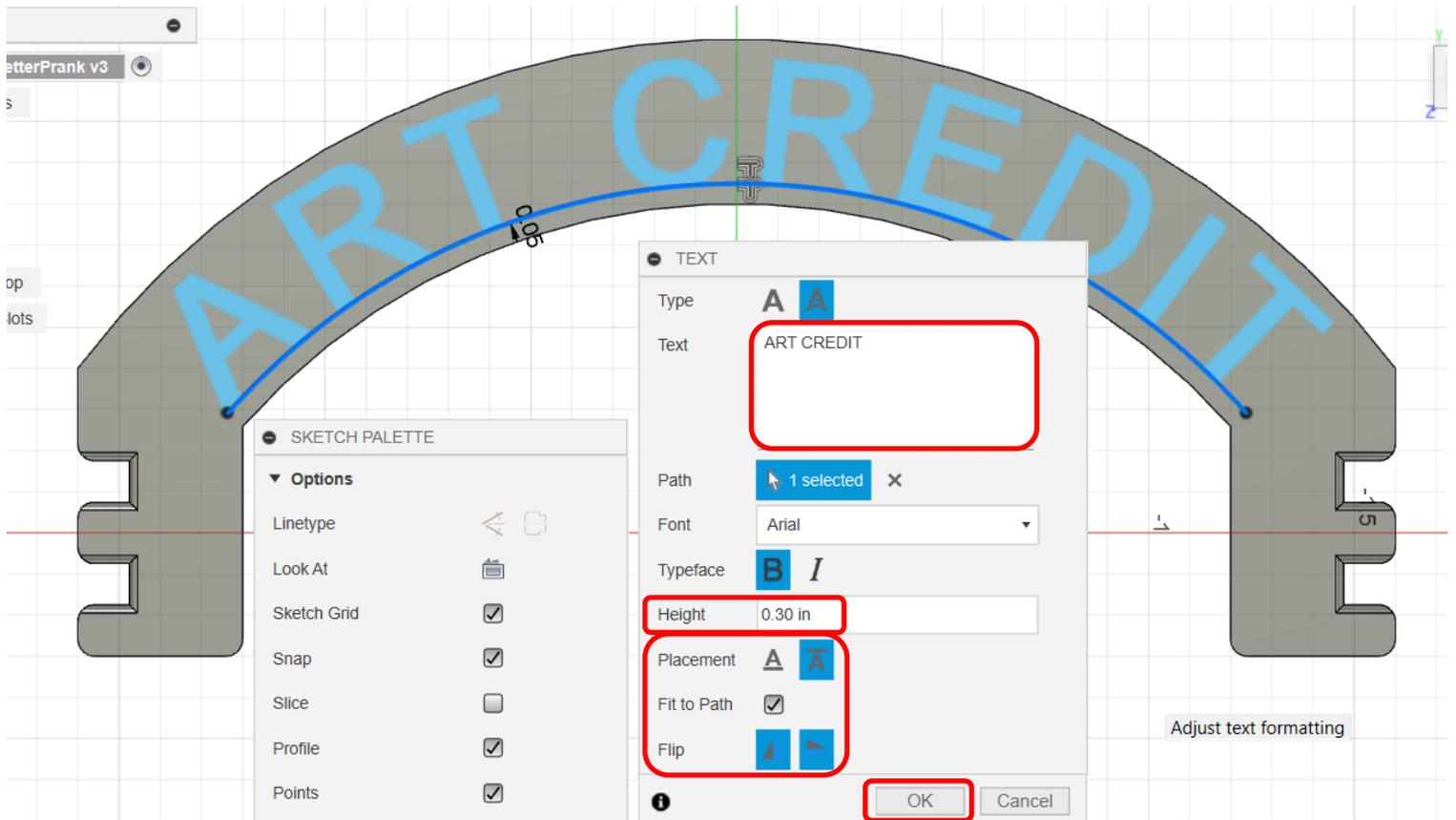


- select the **Text** tool from the **CREATE** menu and click on the **Text on Path** icon
- click on the **arc** that was created in the previous step



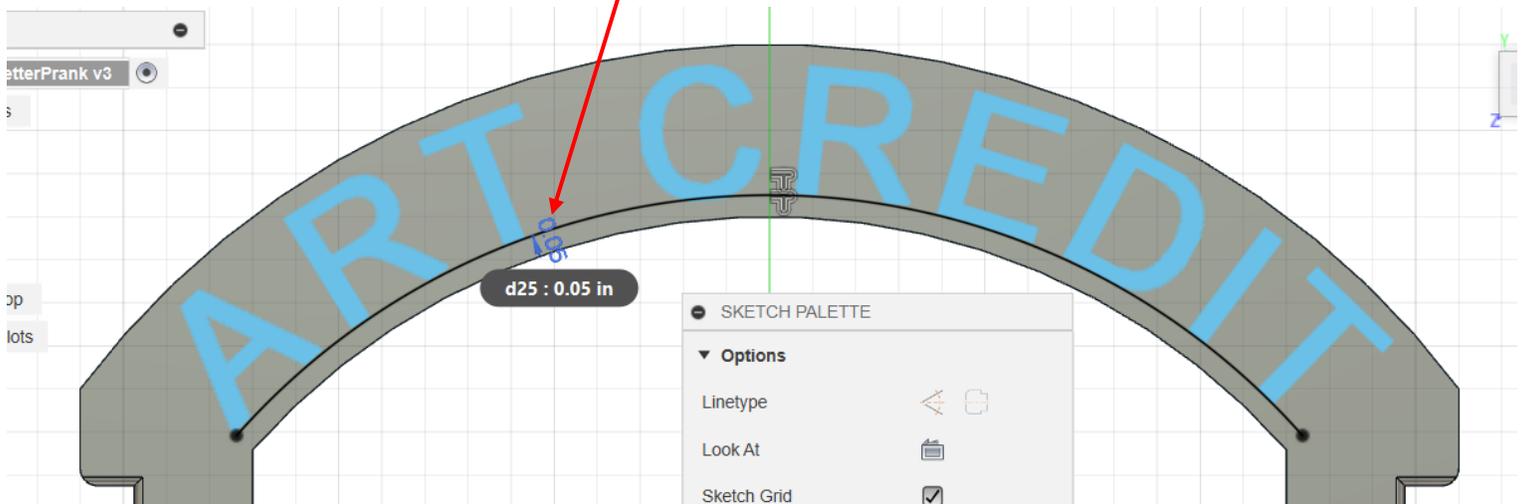
There is a lot to set here because of the many text options available and the initial text position may be way wrong.

- change the **Placement** and **Flip** options to correct the text placement
- change the **Height** to **0.30**
- change the **Text**. Note that all capitals are used so that there are no text elements (descenders) below the base line. If one wishes to make more room below the text the offset of the path can be changed, as shown on the next page.
- click **OK**.

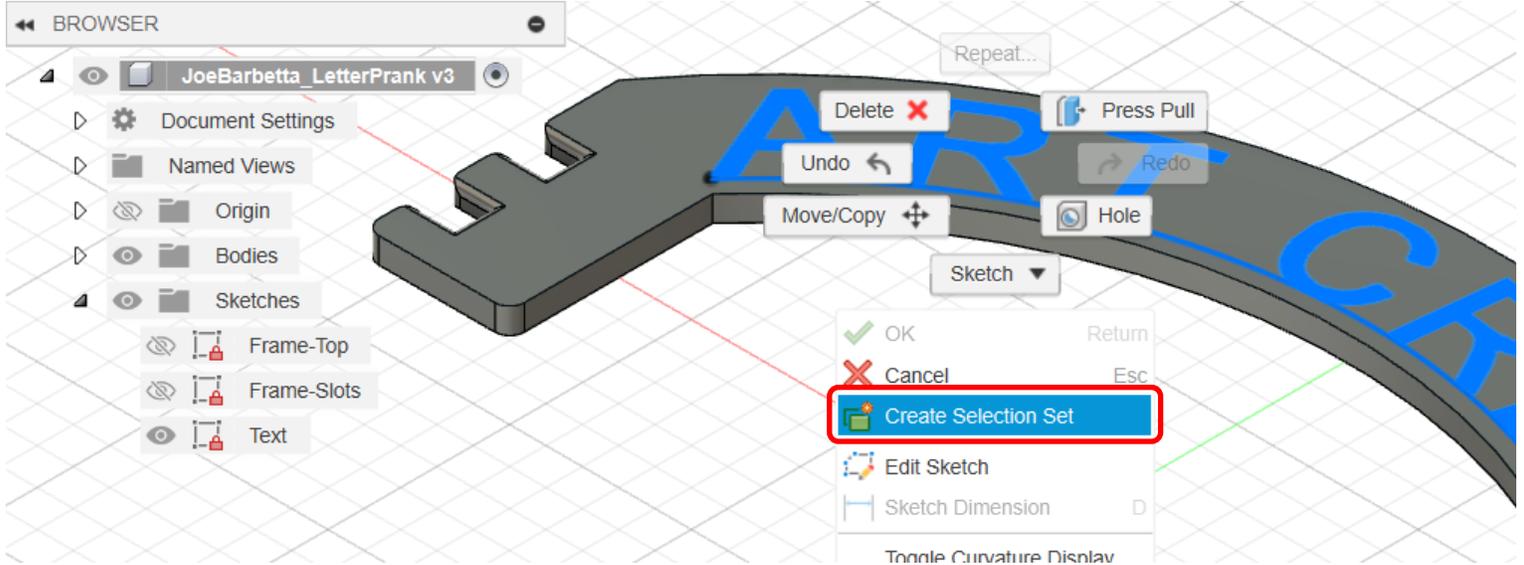


- if desired, one can **double-click on the Offset dimension of 0.05**. This is the distance from the arc to the bottom curved edge. Increasing the value can create room for the font descenders of lowercase letters.

- one can **right-click on a letter** and select **Edit Text** to return to the text options

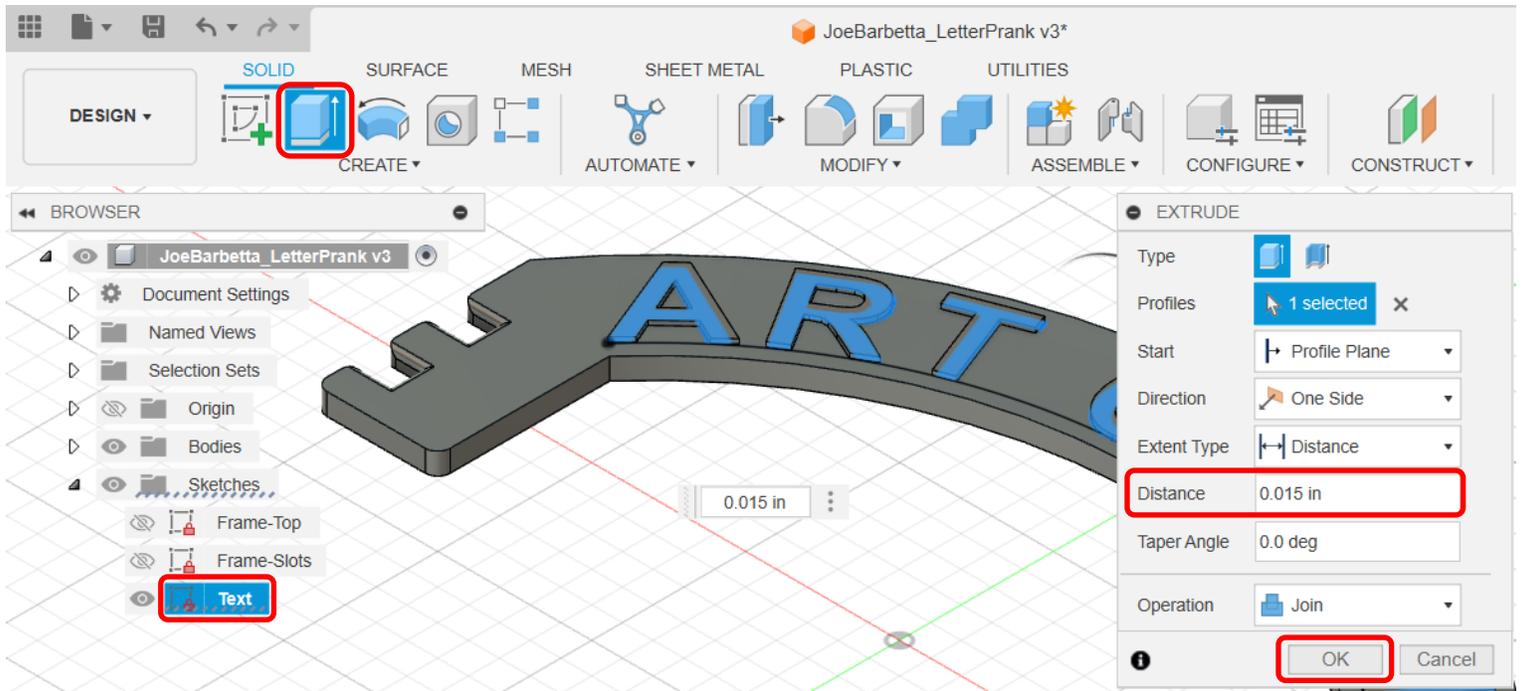


- click **Finish Sketch** to exit the Sketch mode
- right-click on a letter and select **Create Selection Set**
- note that there is also an **Edit Sketch** option if one wants to edit the Sketch and/or any Text on the Sketch



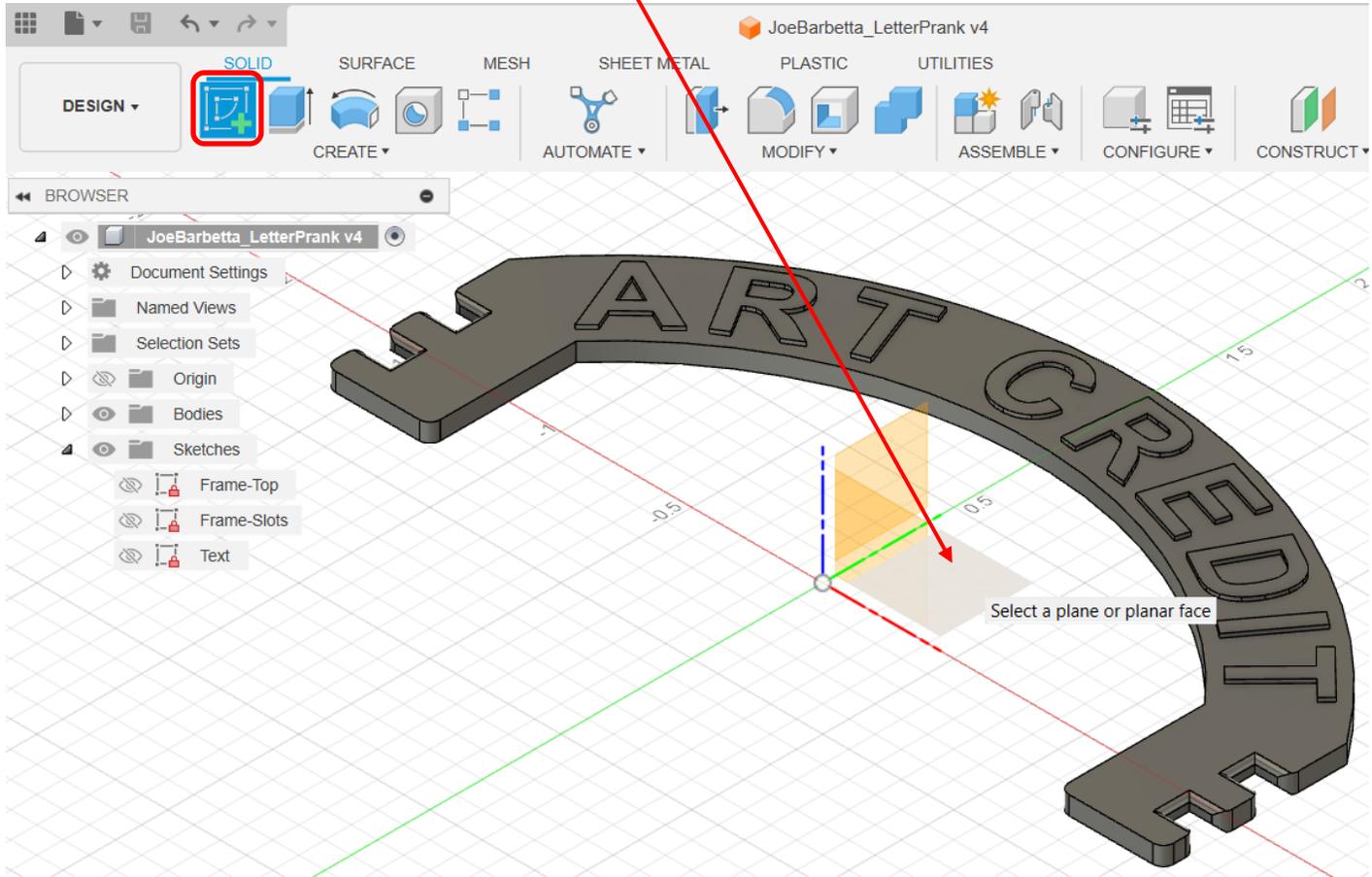
-select the **Extrude** tool and enter a value of **0.015** and click OK. If desired, one can use a negative value for text cut into the surface.

There are some fonts, especially “fancy” ones that will not extrude. If the font doesn’t extrude, try redoing the previous Create Selection Set step and retry the Extrude. If it still doesn’t work, right-click on the **Sketch** name in the left side Sketch list and select **Edit Sketch**. Then right-click on a letter and select **Edit Text** to select a new font.

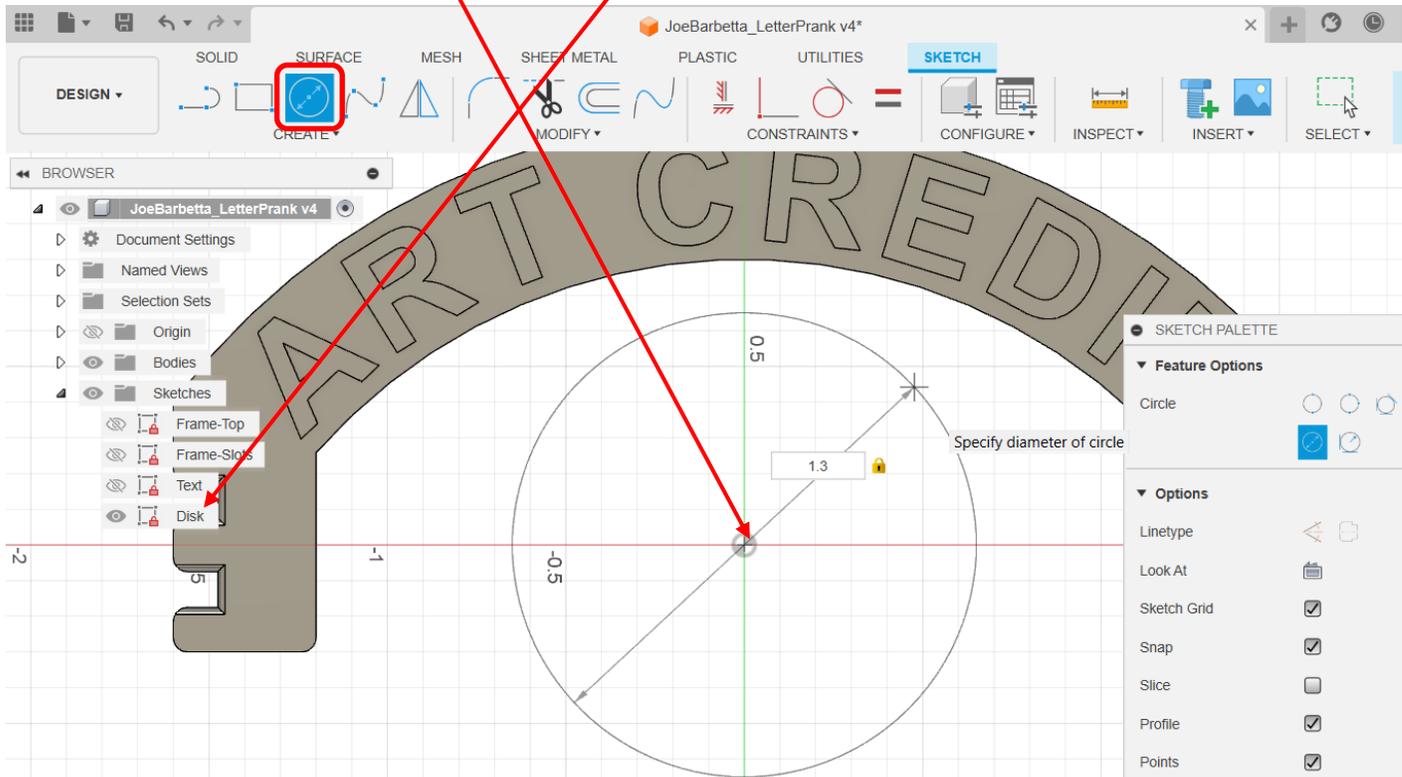


## Creating the disk

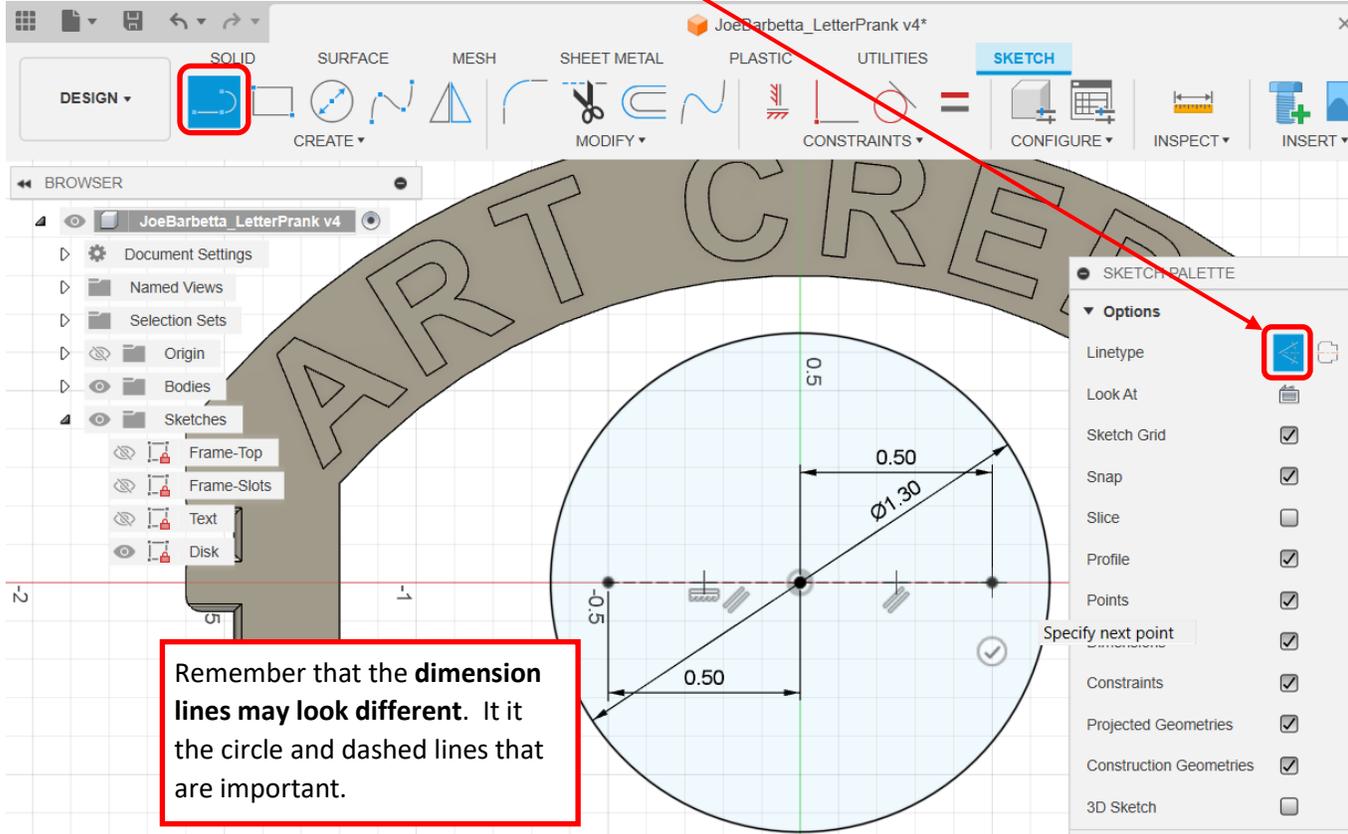
- select the **Create Sketch** tool and click on the **bottom rhombus** to select the X-Y Plane



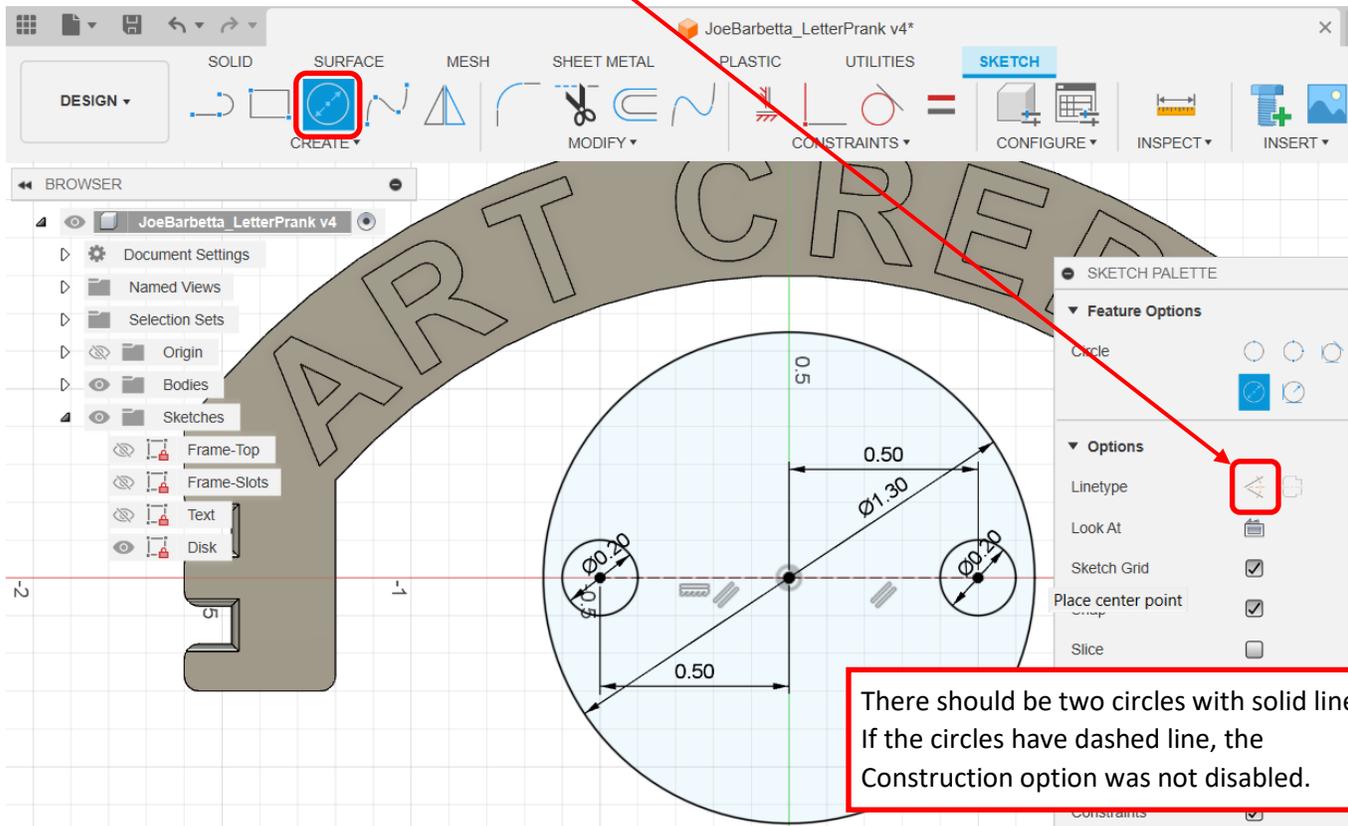
- right-click on the Sketch and rename the Sketch to **Disk**
- select the **Circle** tool, click on the **Origin**, type **1.3** and press **Enter**.



- select the **Line** tool and click on the **Construction** icon to highlight it blue
- click on the **Origin**, extend the line **to the left**, type **0.5** and press **Enter**. The line should be dashed.
- do the same as above, but extend this line to the right. If the line is Not dashed, the **Construction** option may not be enabled.

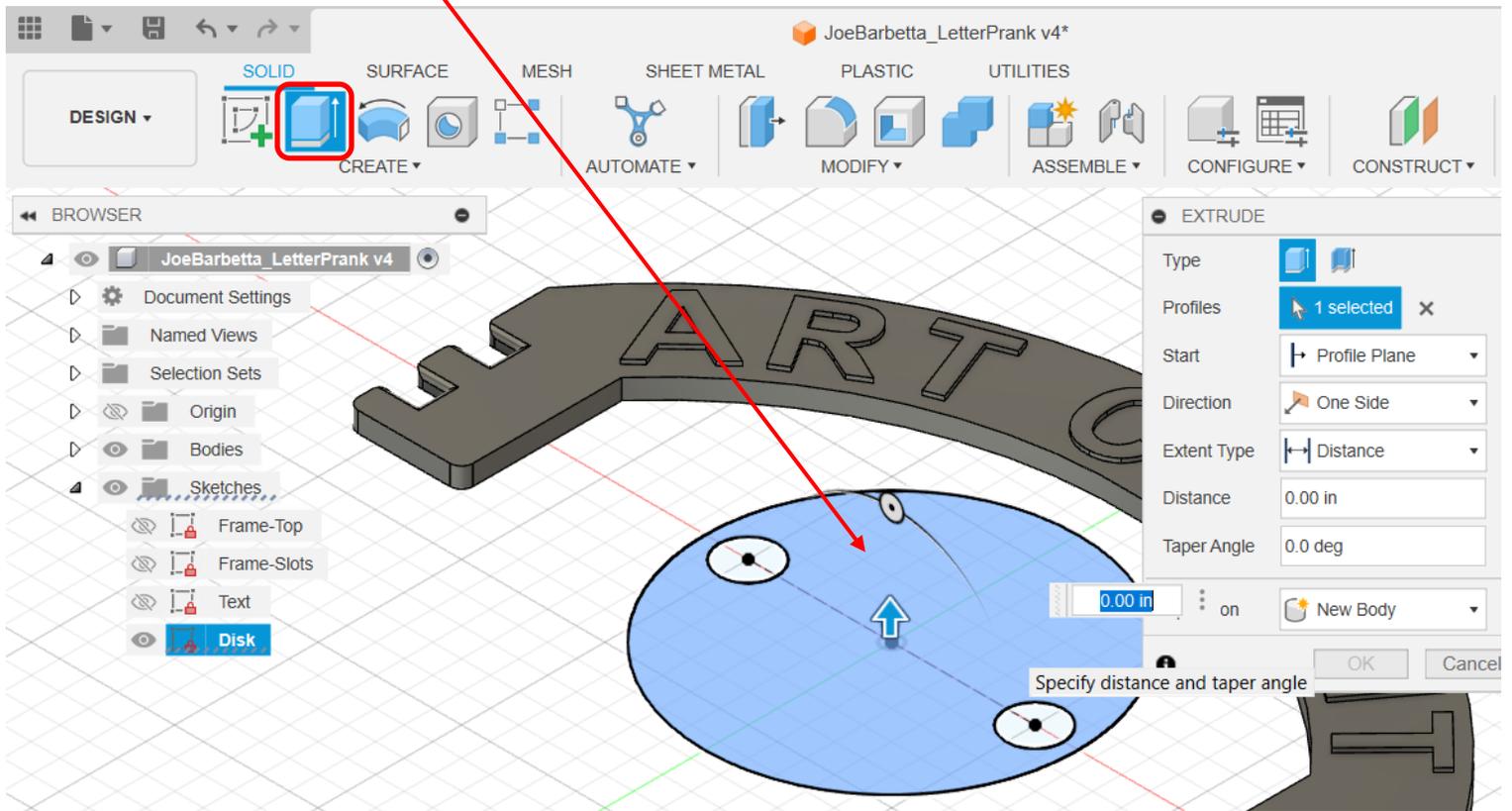


- select the **Circle** tool and click on the **Construction** icon to remove the blue highlighting.
- click on the **end of each dashed line**, type **0.2** and press **Enter**. Click on **Finish Sketch**.

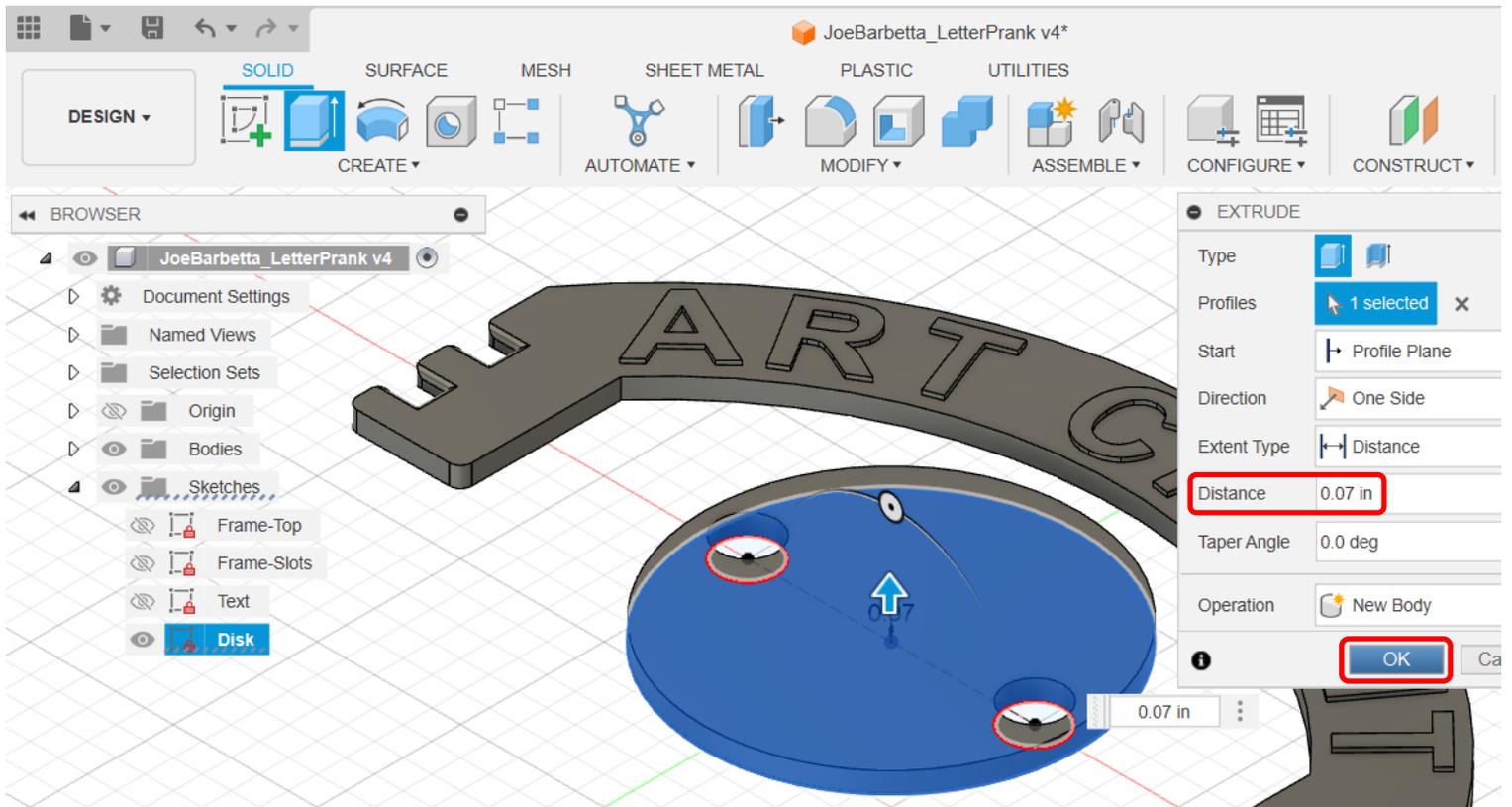


- return to the **Home** view

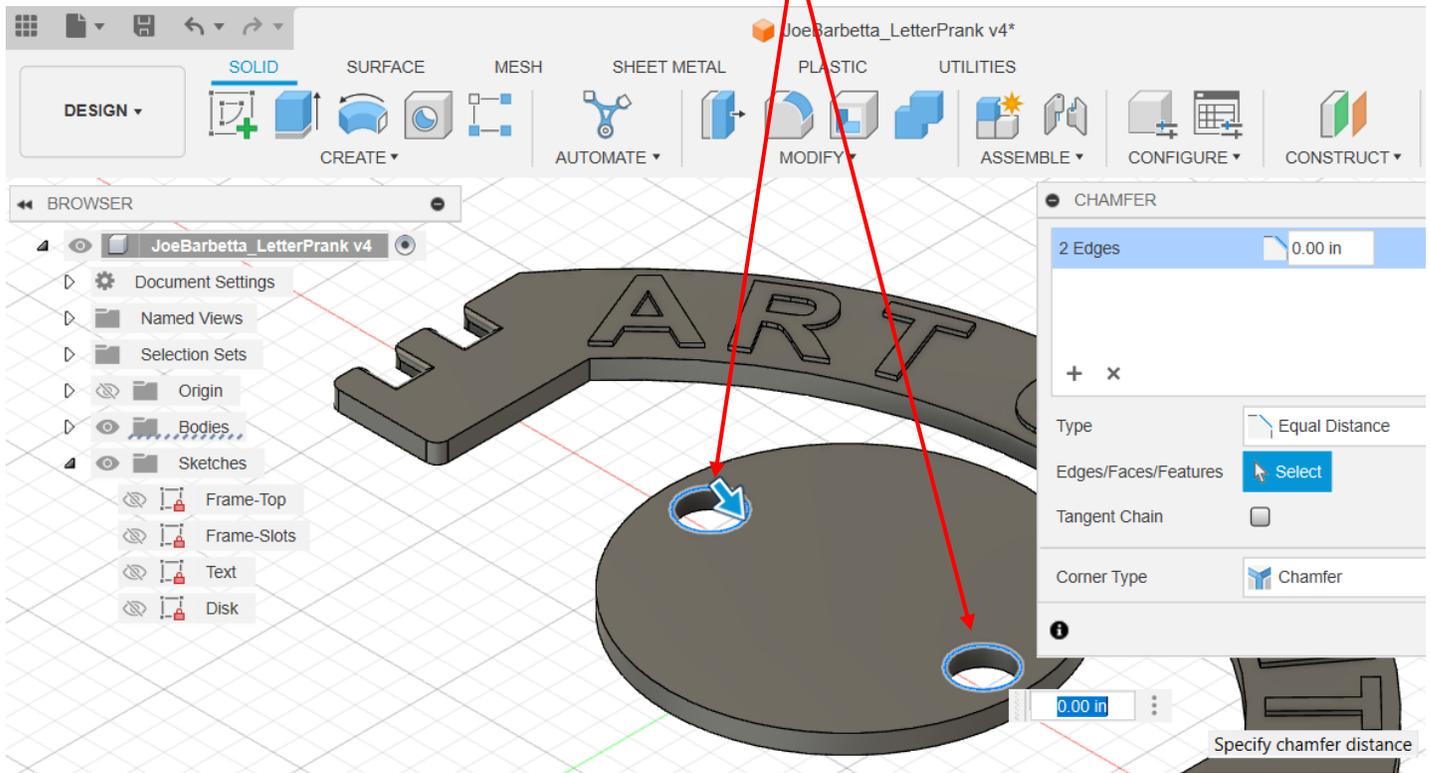
- select the **Extrude** tool and **click on the disk**. Do not click on either small circle.



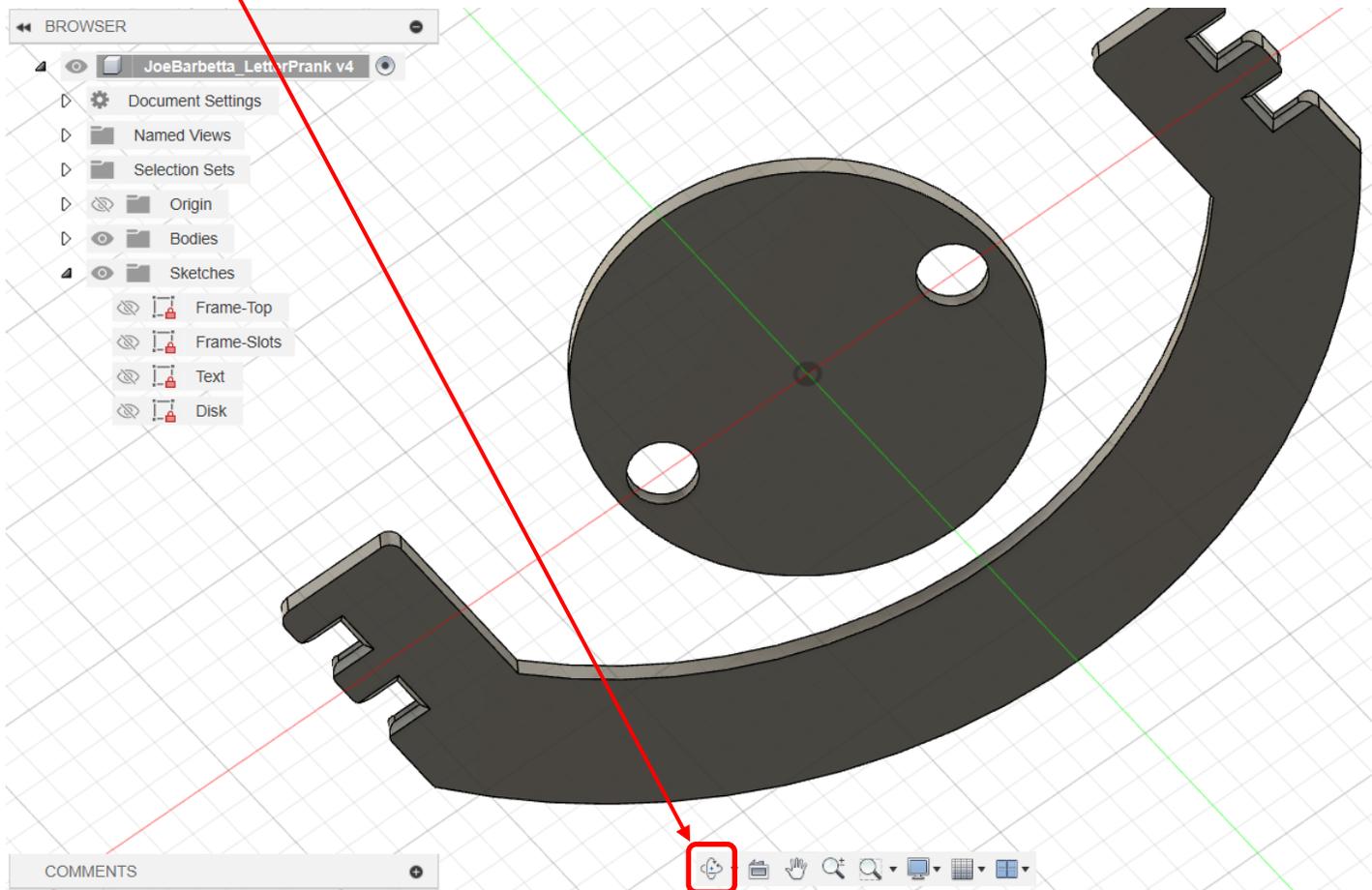
- type **0.07** and click **OK**



- select the **Chamfer** tool in the **MODIFY** menu and click on the **edge of each hole** to cause the edges to turn blue.
- enter **0.02** and click **OK**

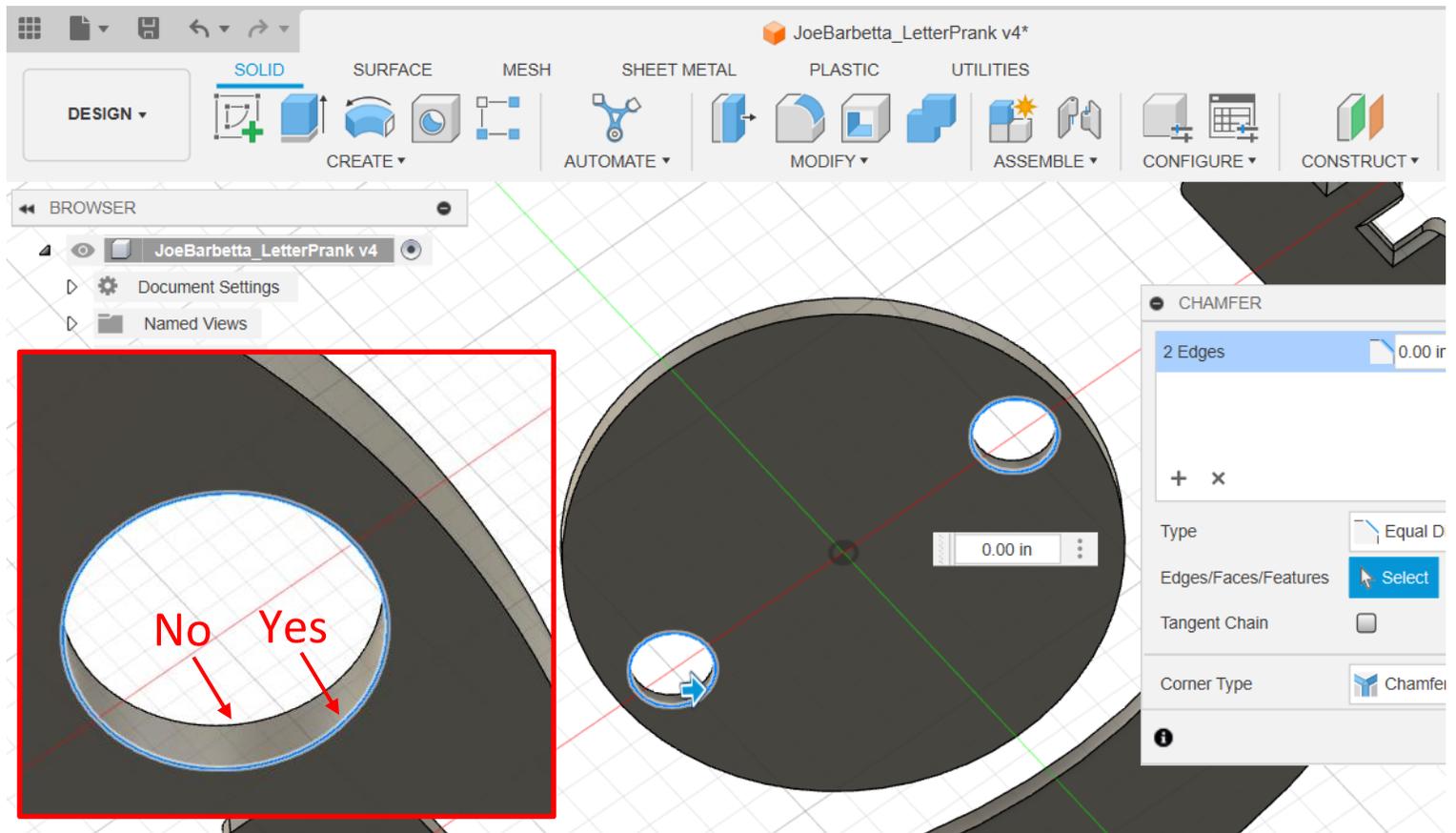


- use the bottom **Orbit** tool and click on the **disk** to rotate the view to access the bottom face.

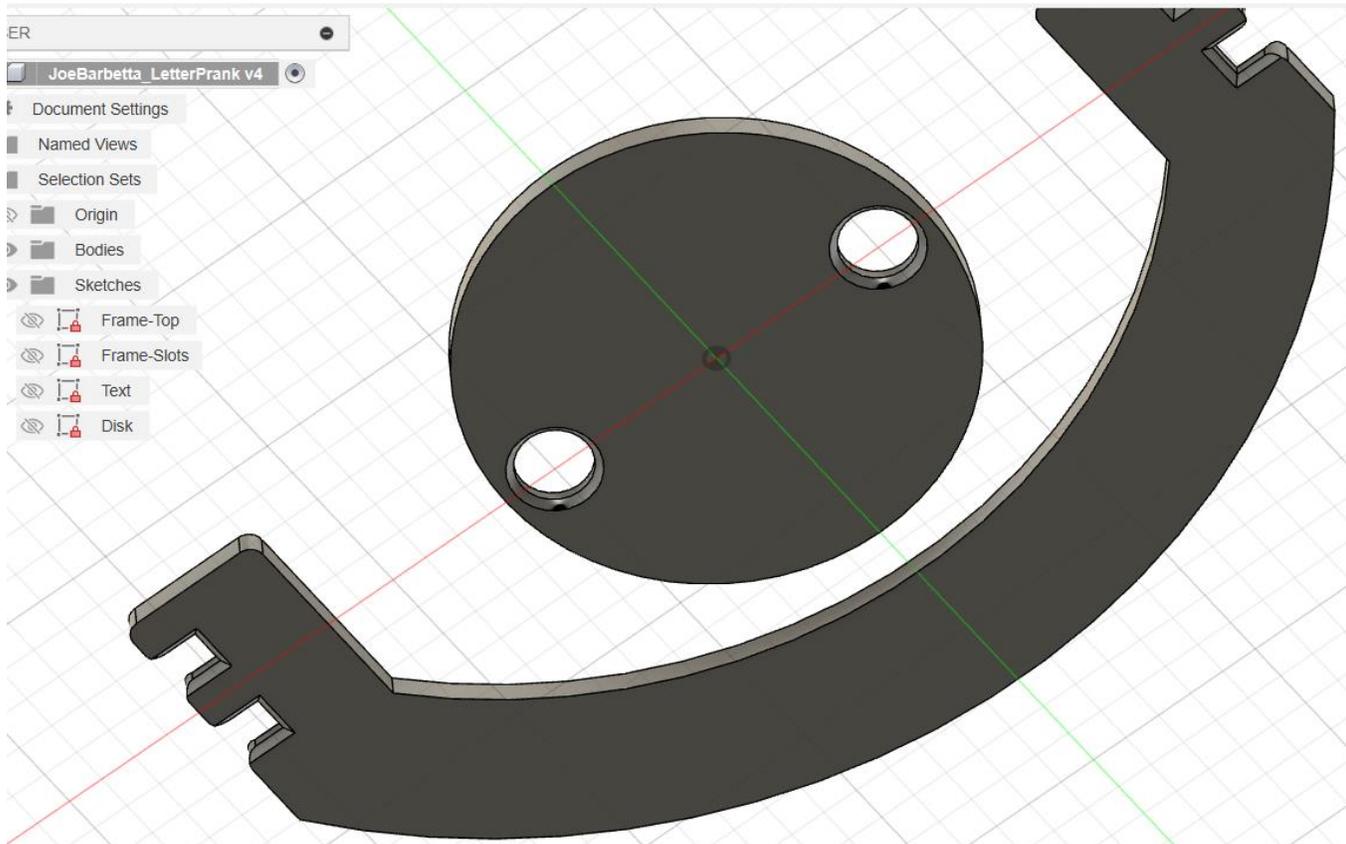


- select the **Chamfer** tool in the **MODIFY** menu and click on the **edge of each hole** to cause the edges to turn blue.

**Ensure that the edges of the top surface are not clicked on. See insert.**

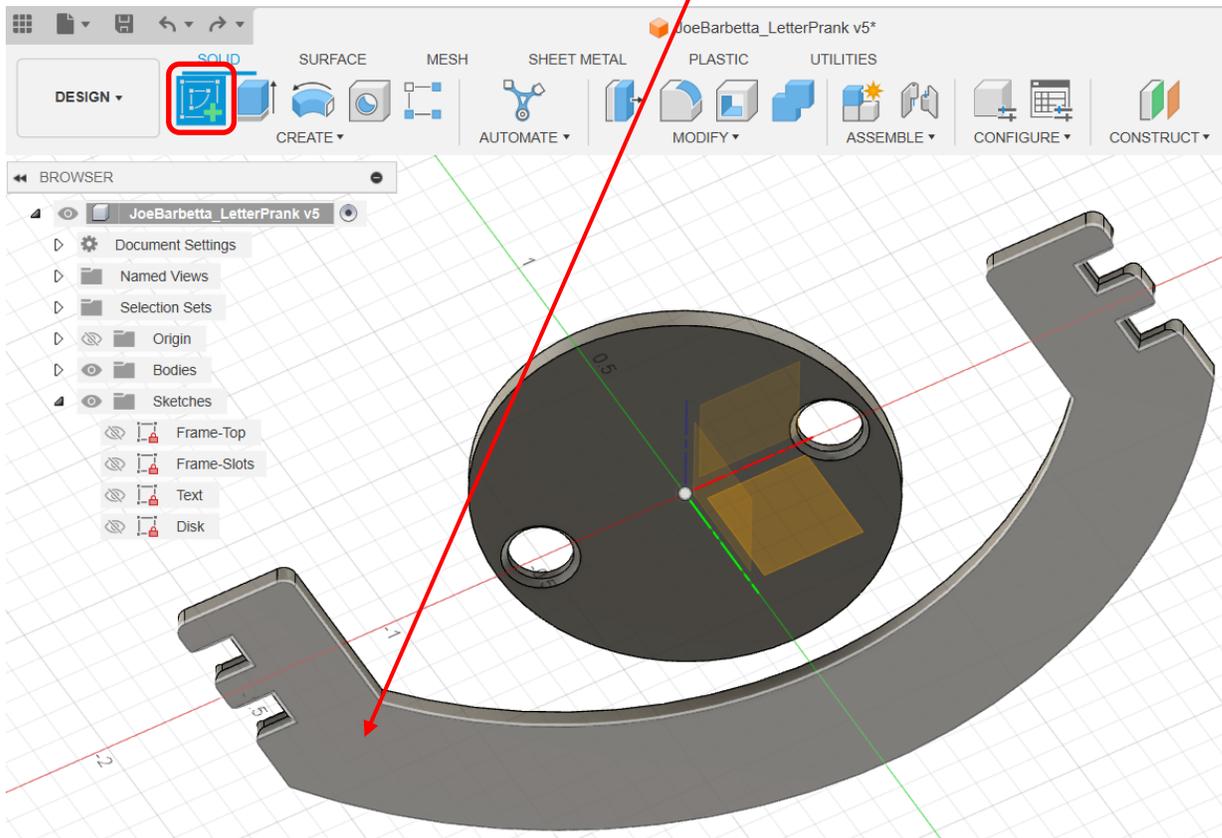


- enter **0.02** and click **OK**. The chamfered holes should look like that below.

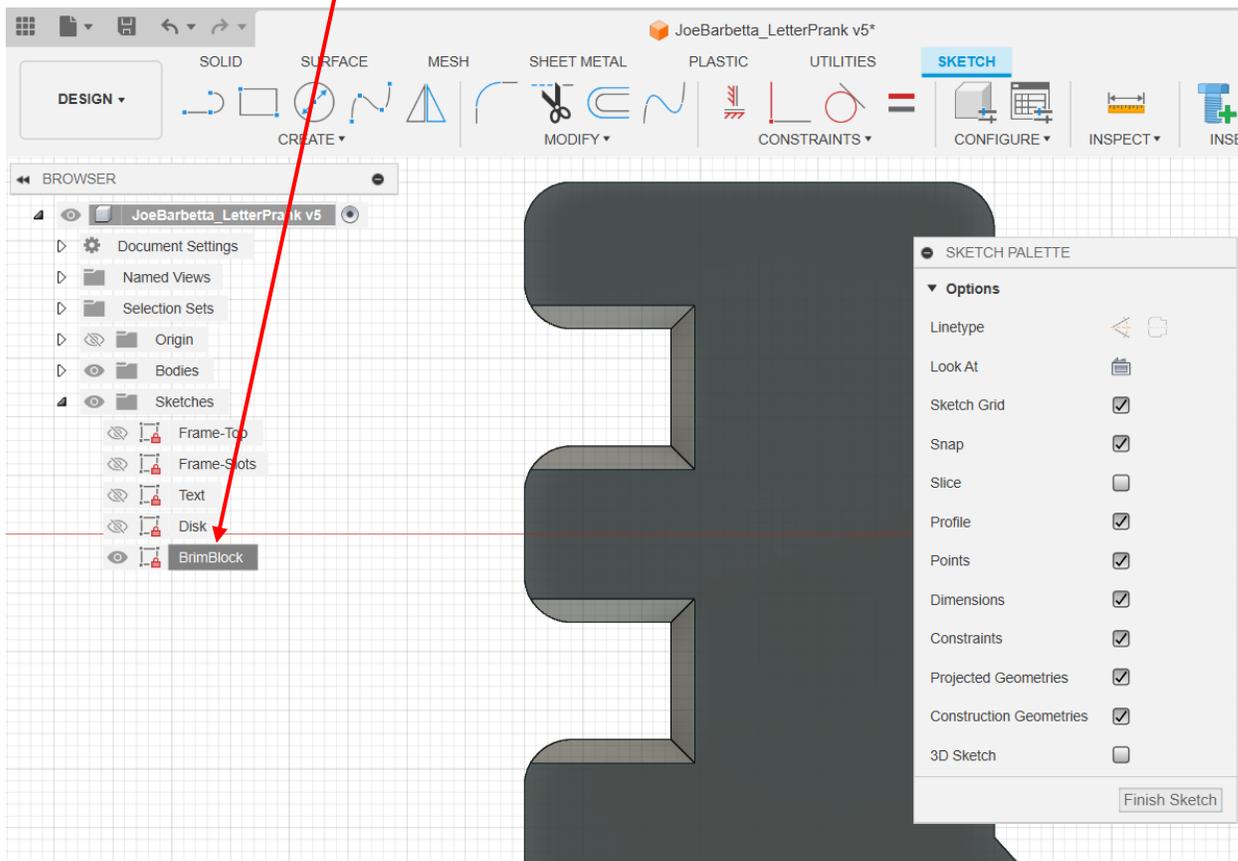


## Creating Brim Blocks

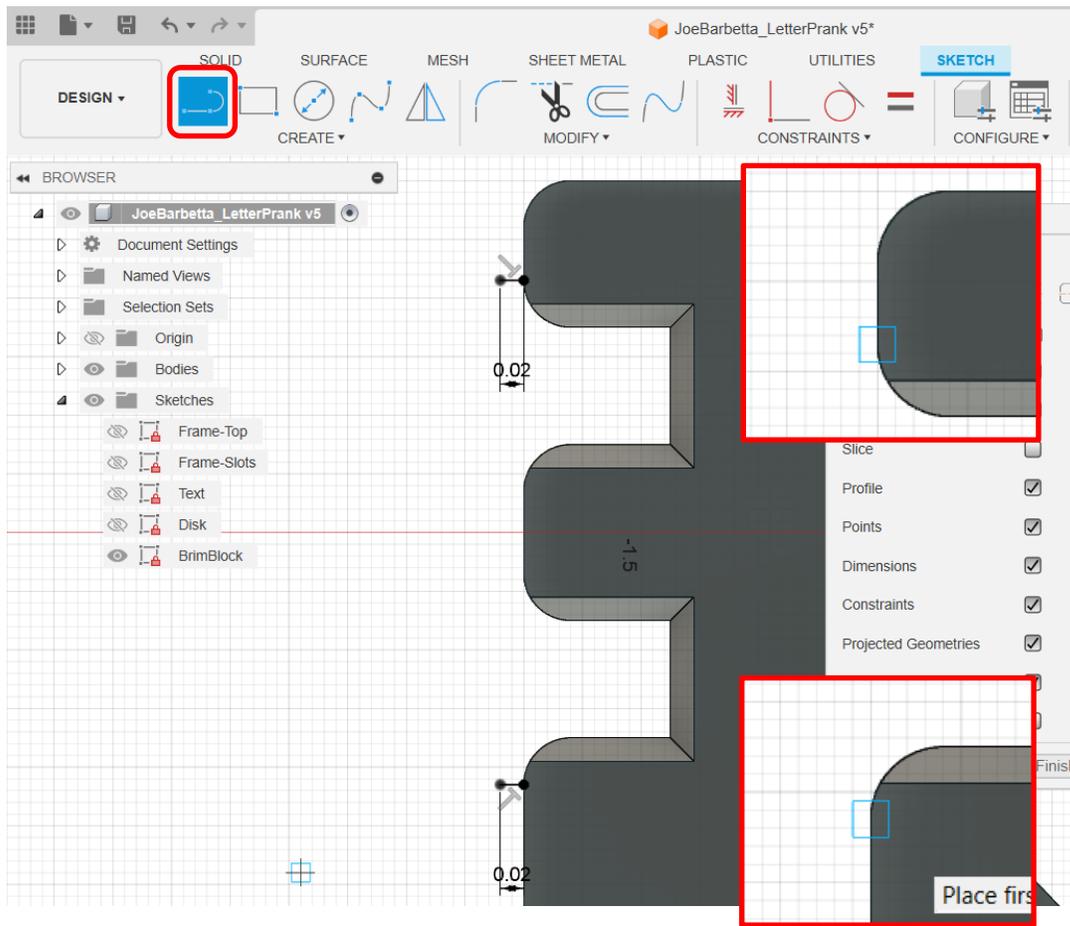
- select the **Create Sketch** tool and click on the **bottom of the frame**



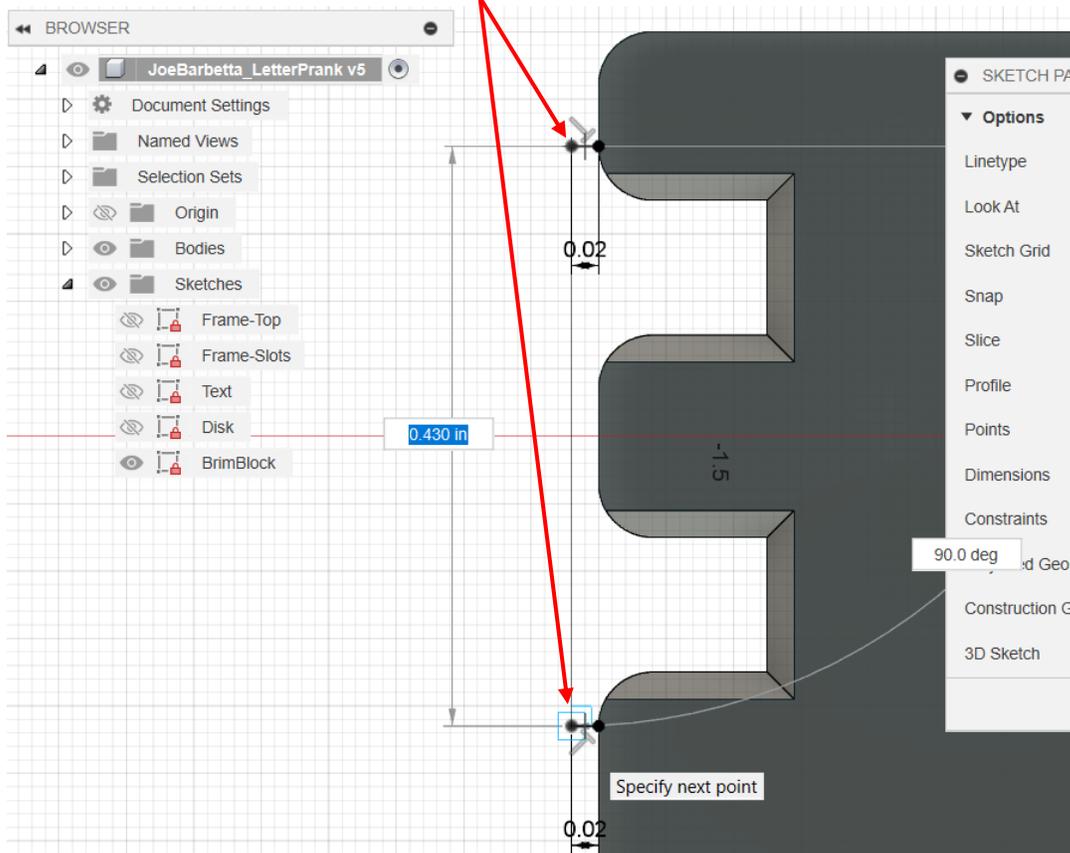
- rename the **Sketch** to **BrimBlock** and use **Zoom** and **Pan** to achieve a view similar to that below



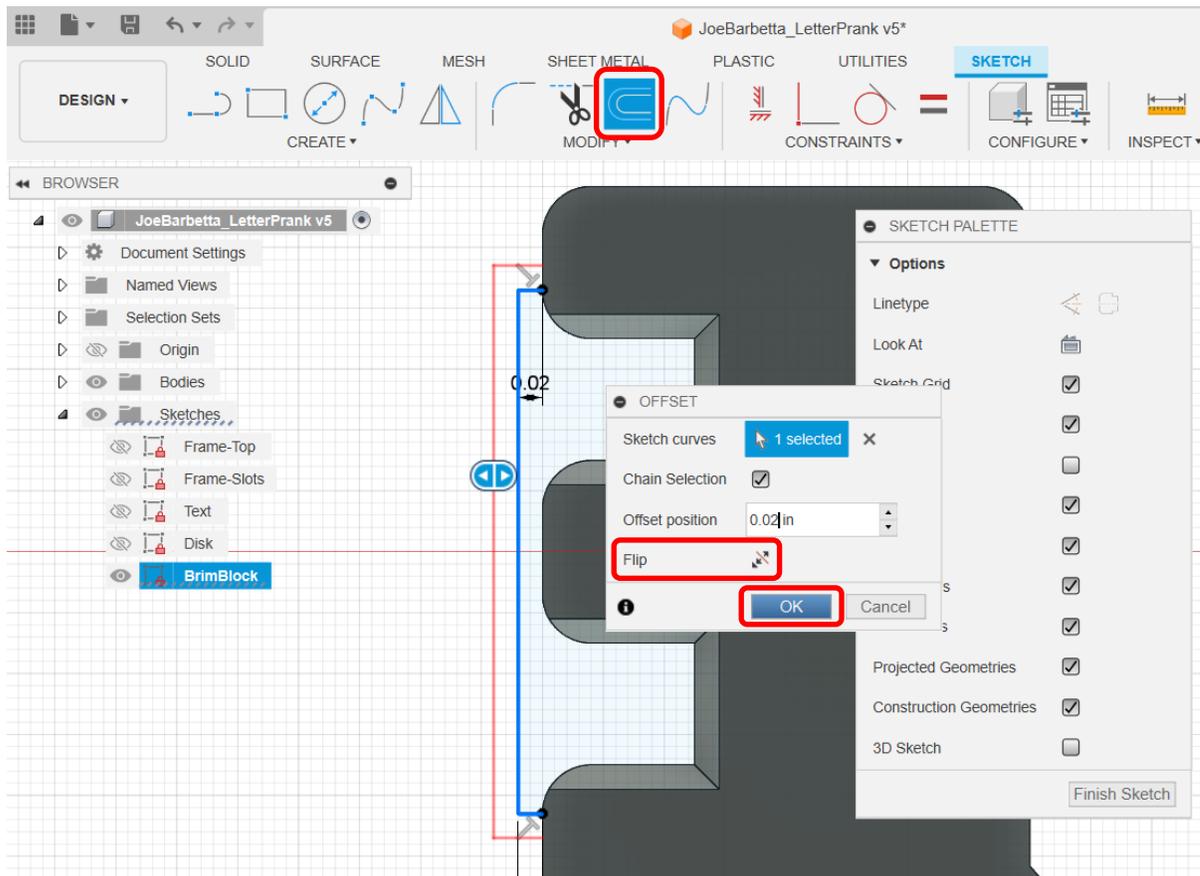
- select the **Line** tool and create two horizontal line segments that are **0.02** long. When placing the start of the line, a **blue square** will appear, as shown in the insert closeups.



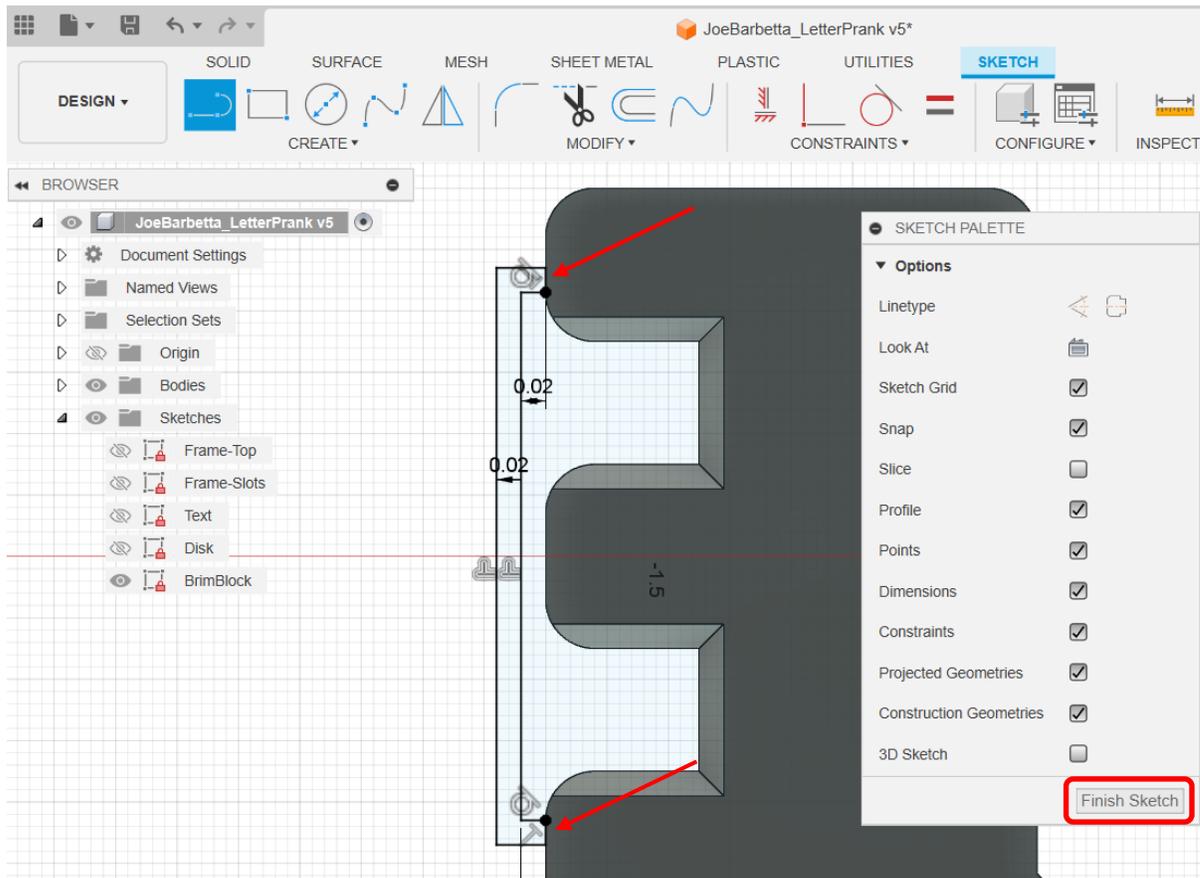
- create a vertical line between the **left ends** of the two horizontal lines just drawn



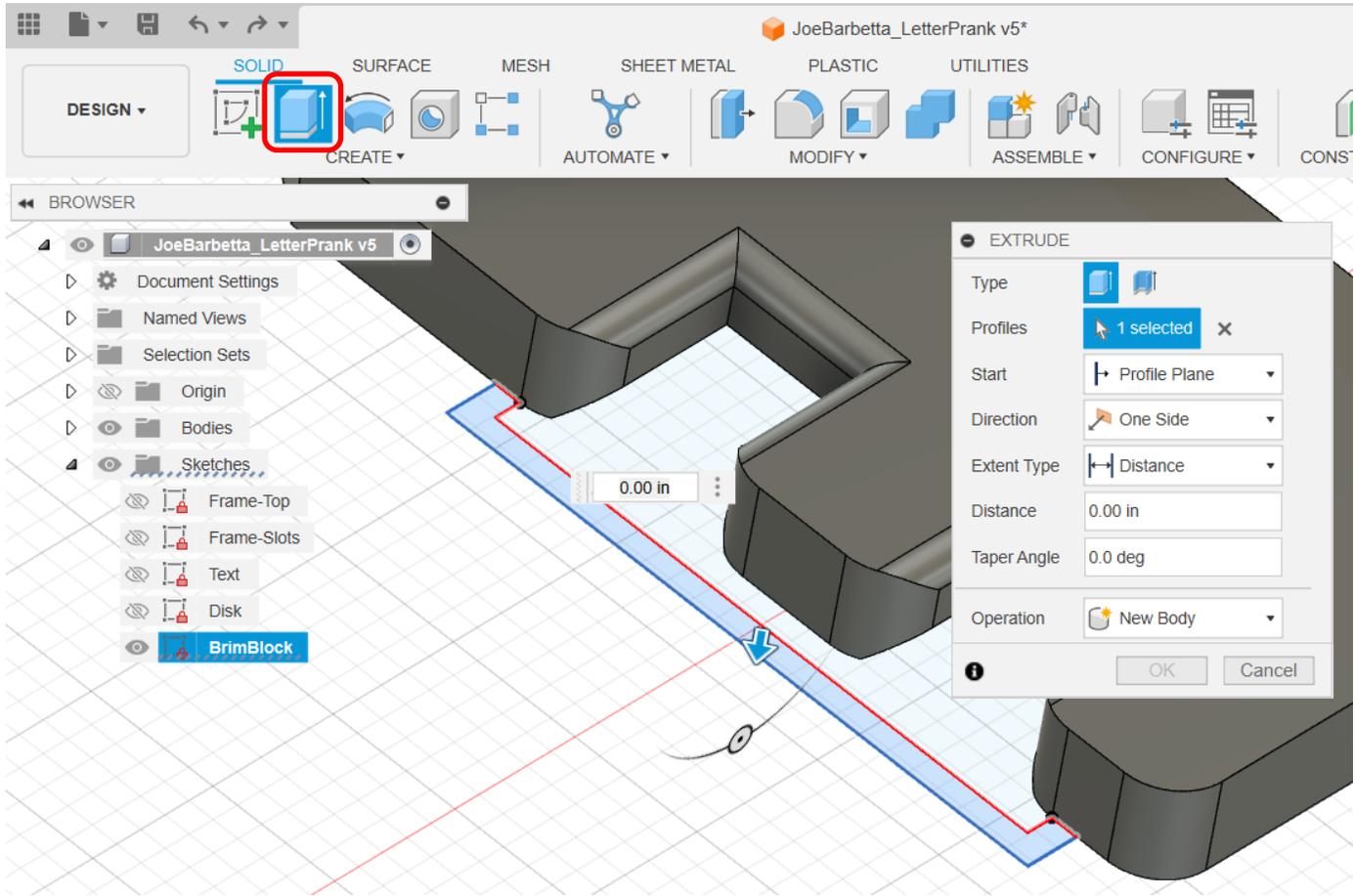
- select the **Offset** tool and click on the line just drawn. Type **0.02** . If the red line does not appear to the left, click on the **Flip** icon. Click **OK**.



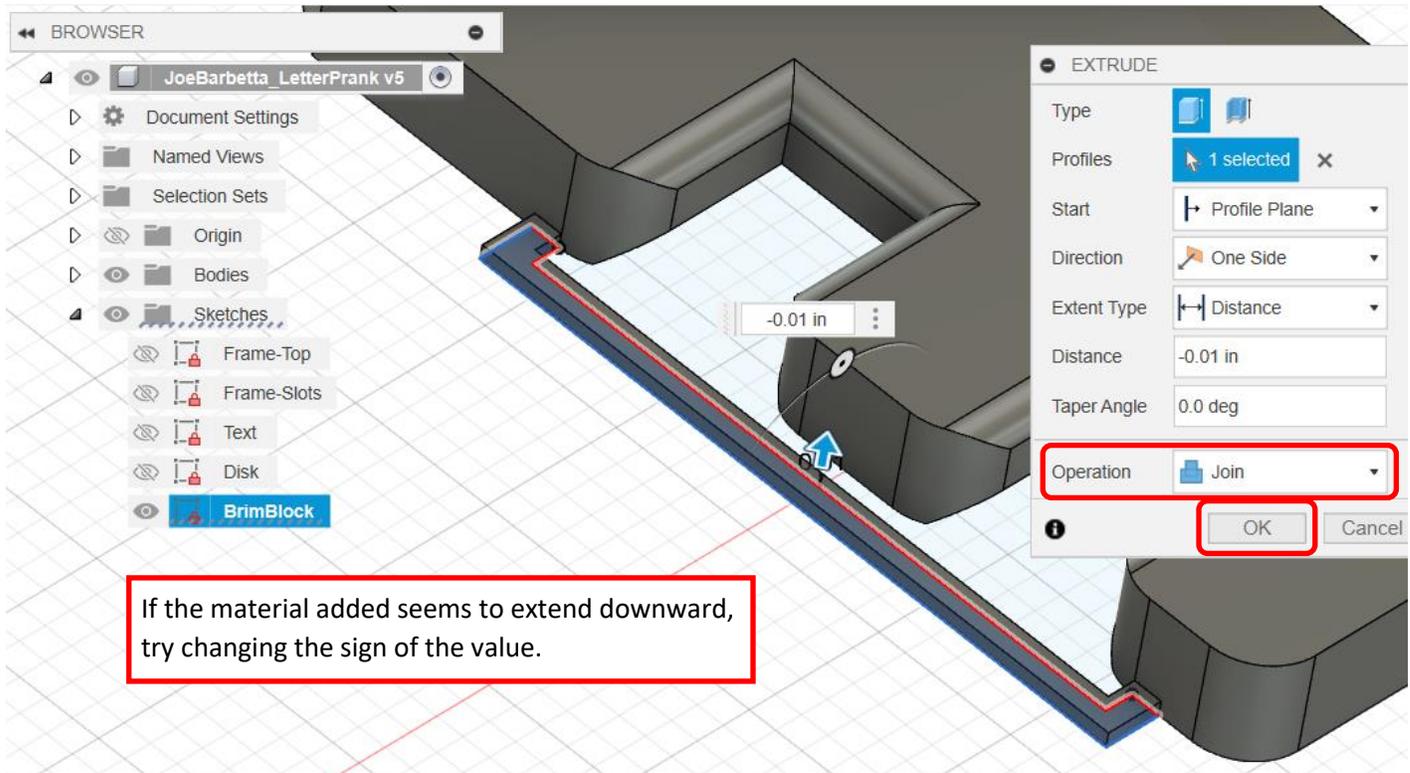
- use the **Line** tool again to create two short vertical lines to close the shape just created. Click **Finish Sketch**.



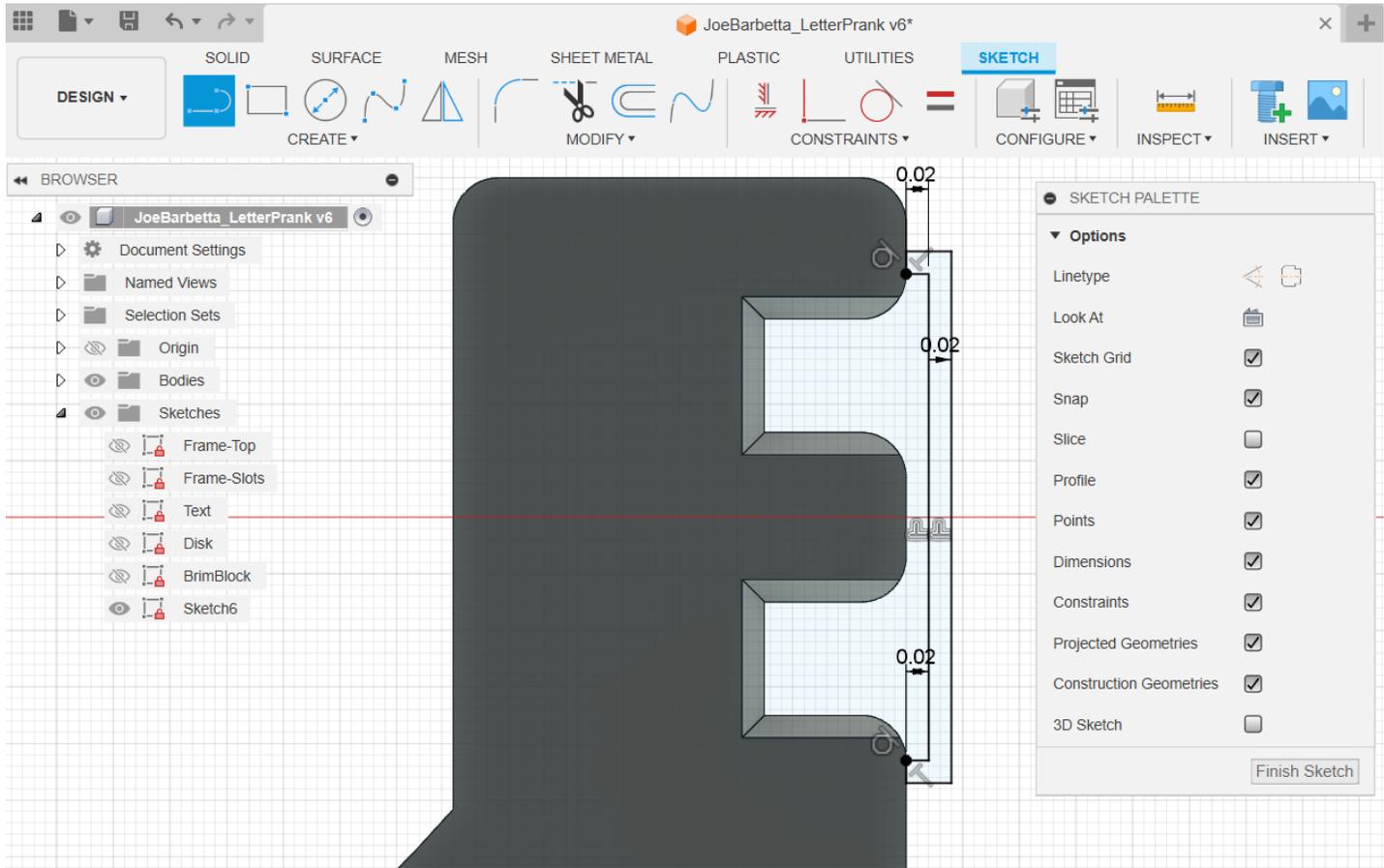
- change the view to that similar to below
- select the **Extrude** tool and click on the blue profile.



- type - 0.01 (note the negative sign). Ensure the **Operation** is Join. Click **OK**.



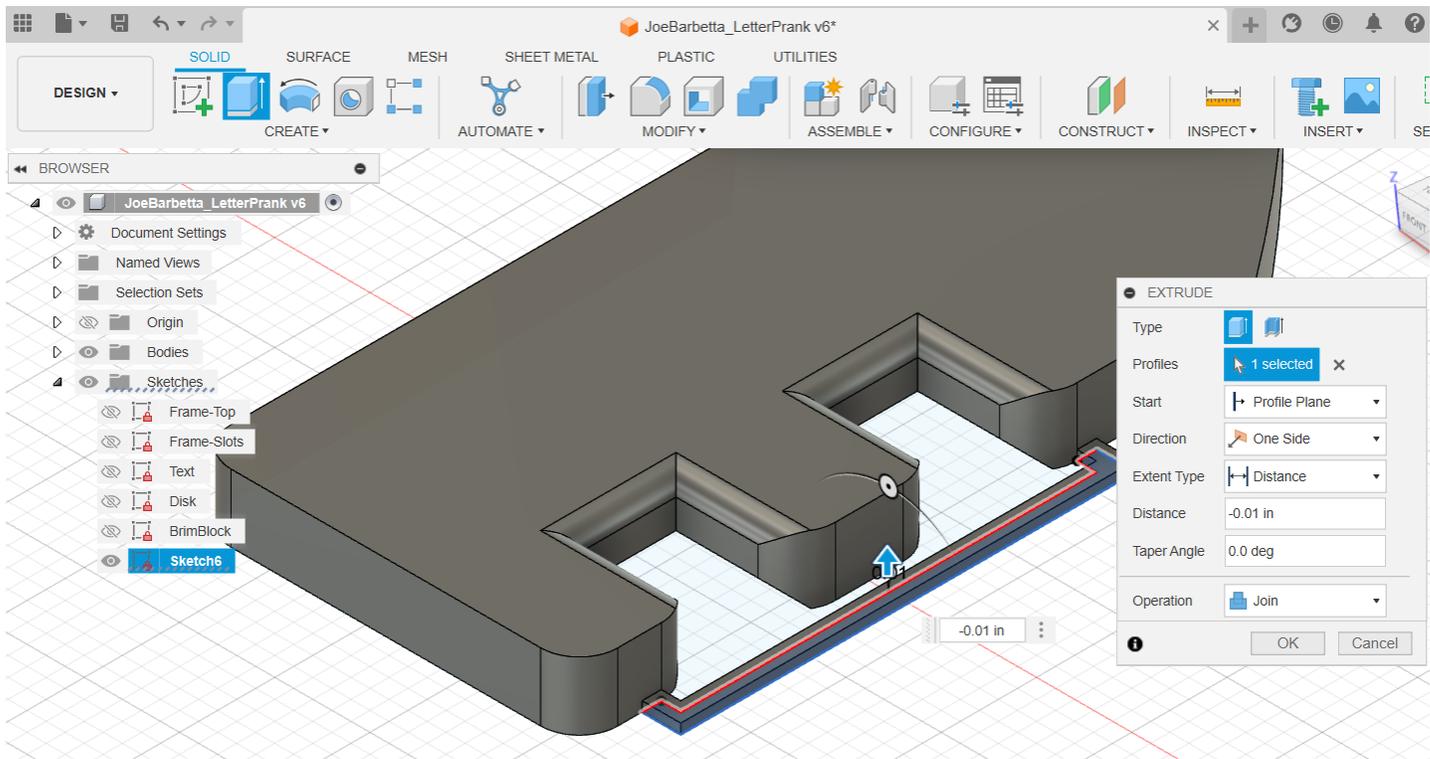
- as done in the previous few pages, a similar **Sketch** must be created on the bottom of the opposite frame end.



- the Sketch just created must then be Extruded, as done previously on the opposite end.

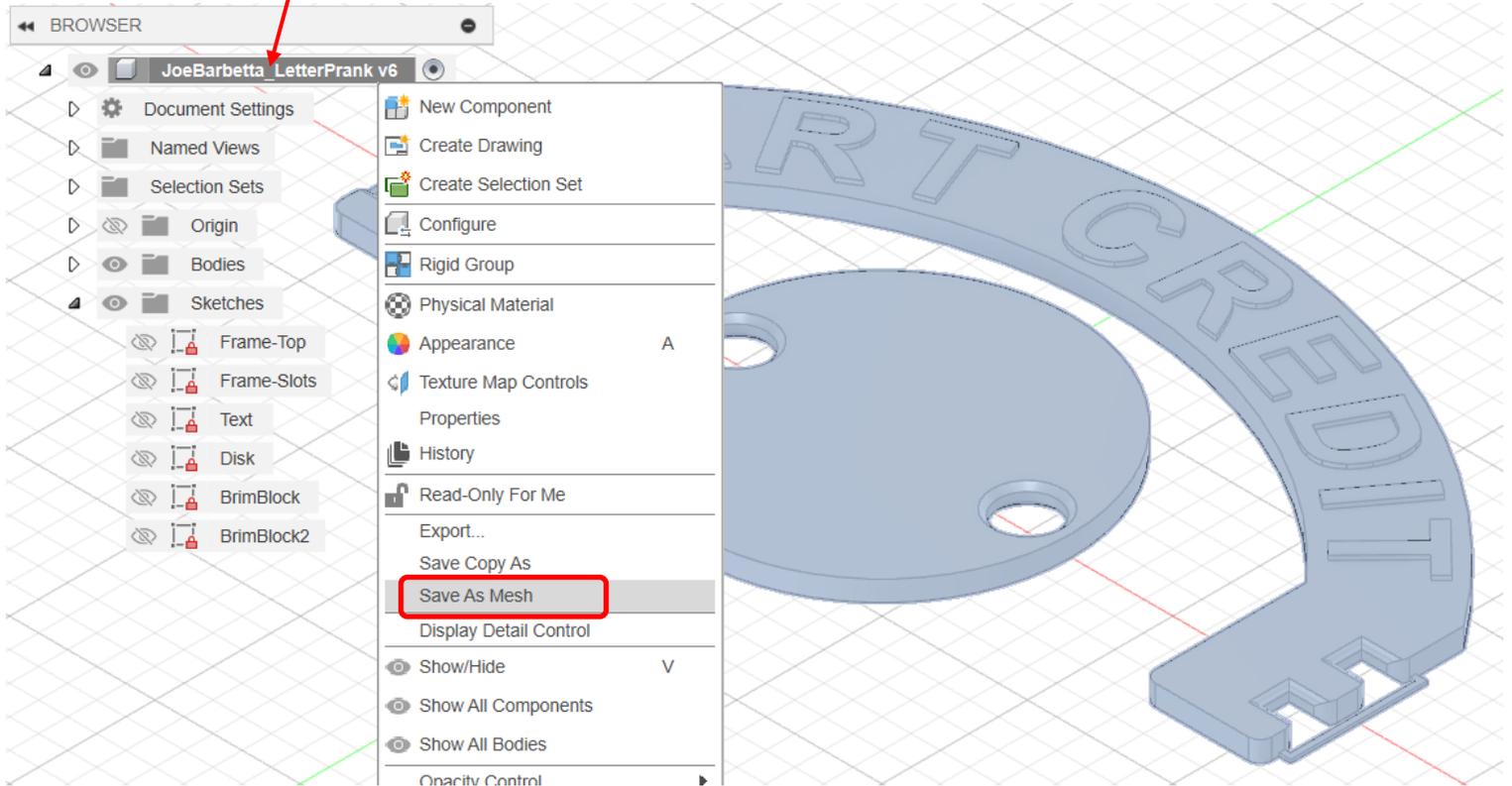
**Couldn't we have saved time and created a Brim Block before we performed the mirror operation ?**

**Yes. The teacher had a brain fart and forgot to create the Brim Block before the mirror operation.**

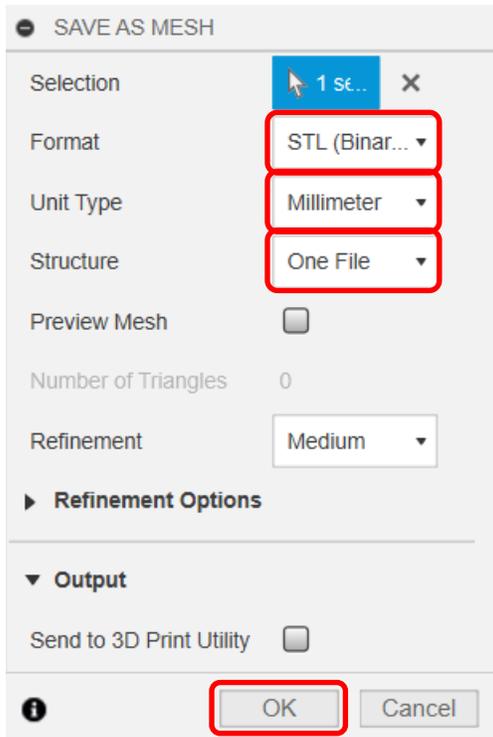


## Exporting the .stl file

- right-click on the **Project Name** and select **Save As Mesh**

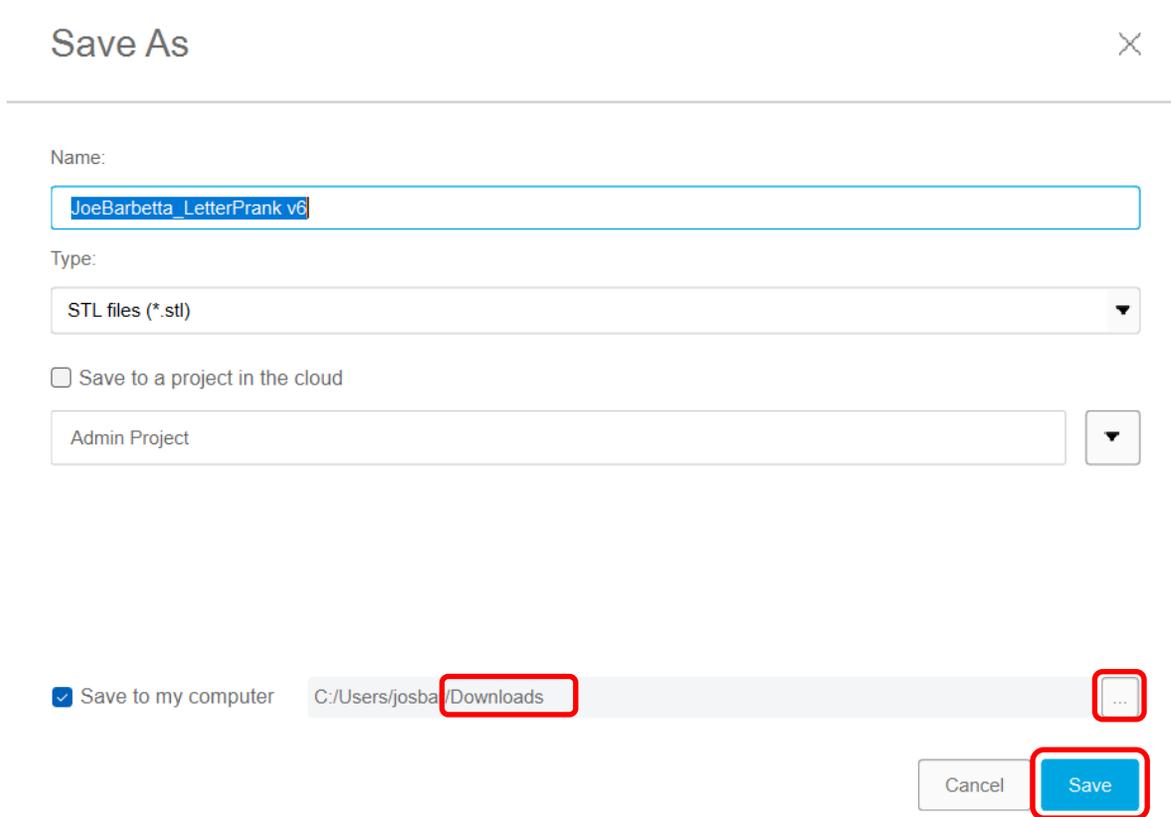


- ensure the settings are as below and click OK



As shown here, the .stl file should save to your Downloads folder. One can always use the right side navigation option to change the folder.

- click Save



- submit the .stl file and a screen shot (with the left side Browser section showing the Sketch names) as below.

