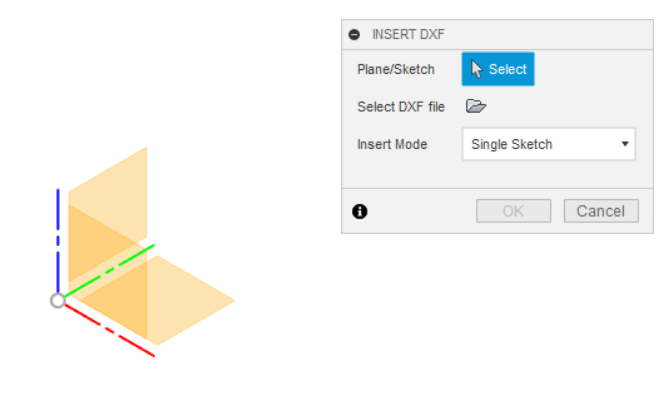
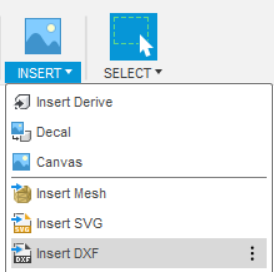
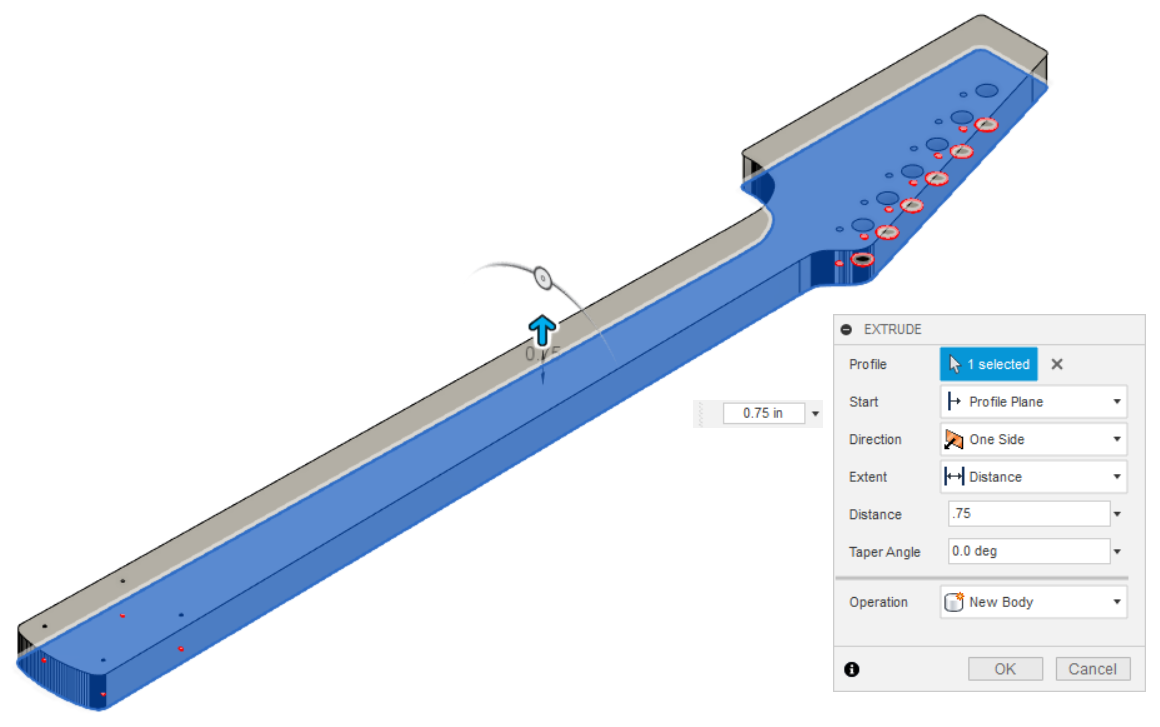
Advanced 3D CAD for Guitar Necks

**Description of Activity**

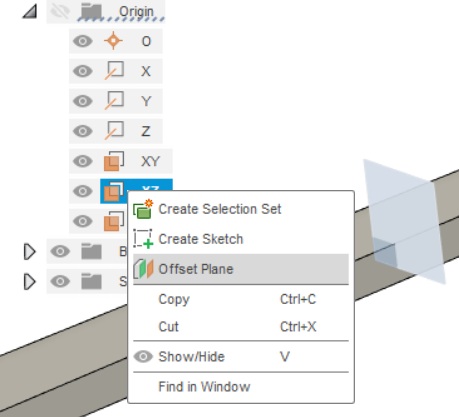
In AutoDesk Fusion 360, begin by choosing Insert🡪DXF.



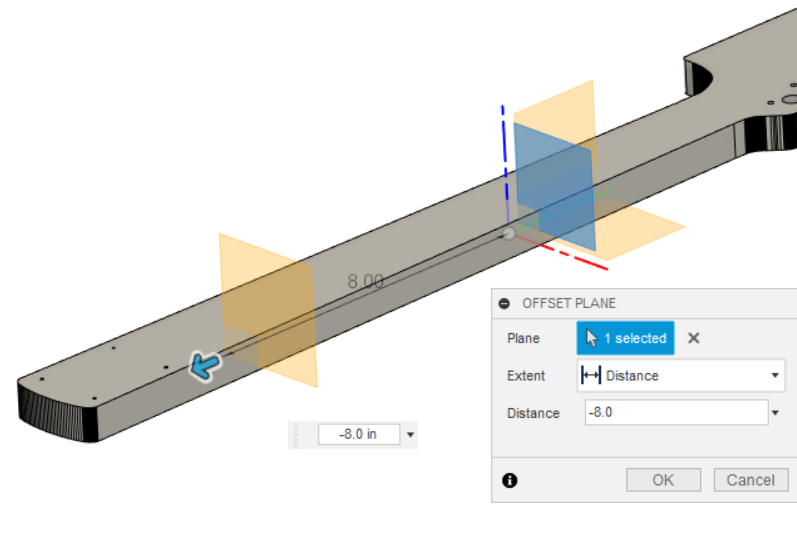
Find the DXF file for the neck. When prompted for a plane, choose the XY plane (red and green axes lines.) Extrude the sketch 0.75 inches.



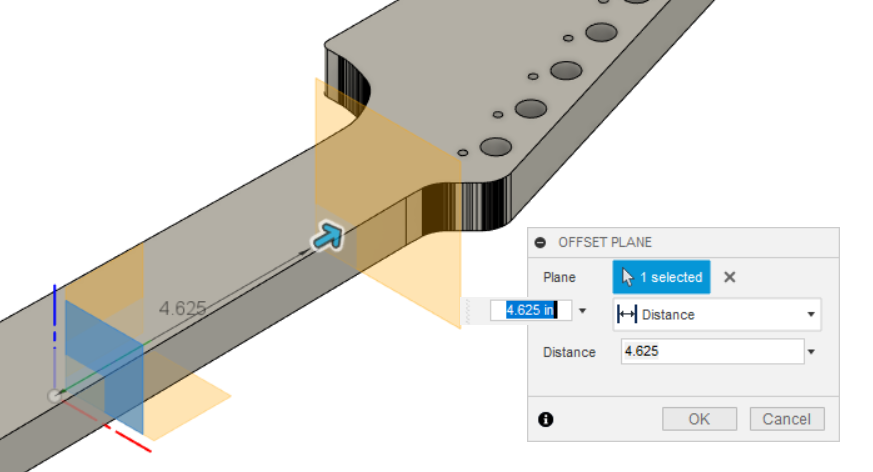
\* This particular sketch already has holes for the tuners and neck mounting bolts already established. When you extrude the neck, those holes will already be created for you.



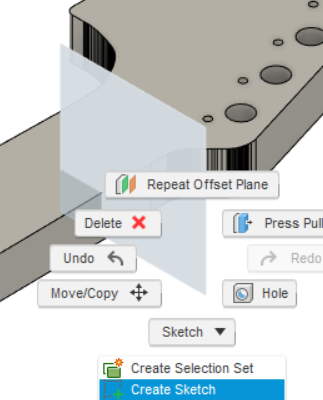
Next, we need some workplanes at each end of the main run of the neck. One will be near the heel, and the other will near the string nut. At the origin, right click on the XZ axis, and choose Offset Plane



Create a workplane 8” inches from the origin, going toward the heel.

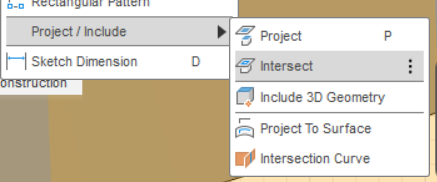


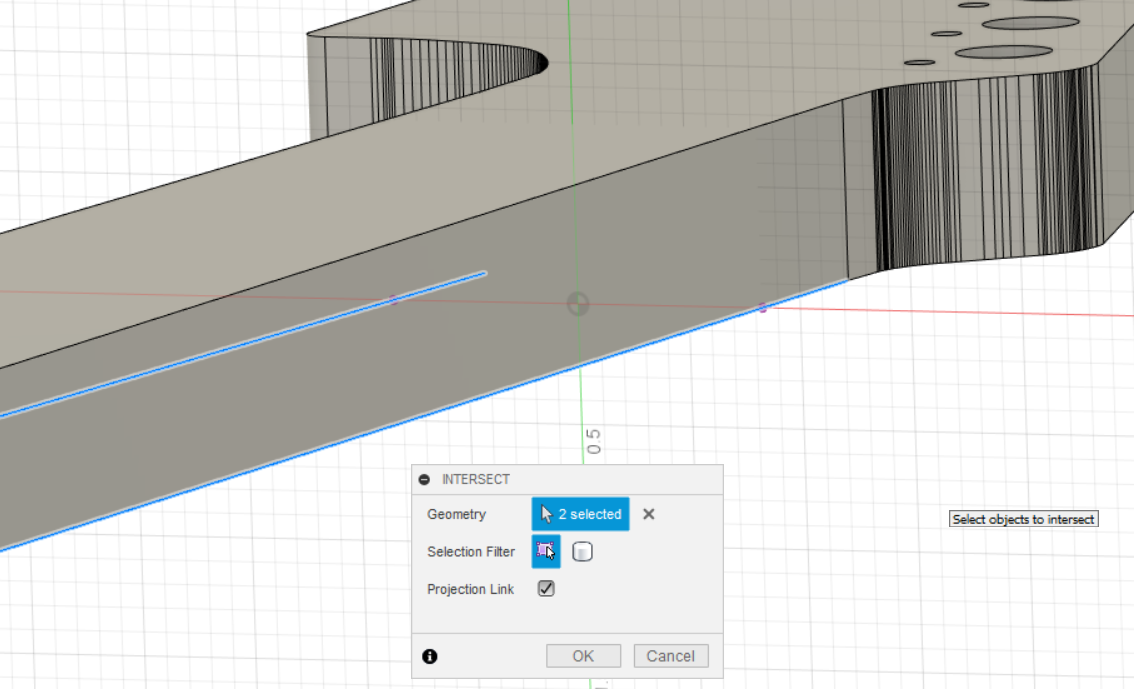
Create another workplane 4.625” from the origin, going toward the headstock.



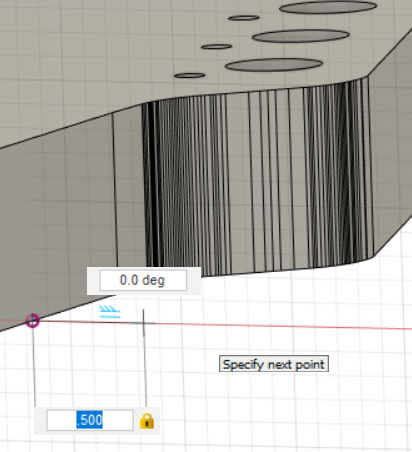
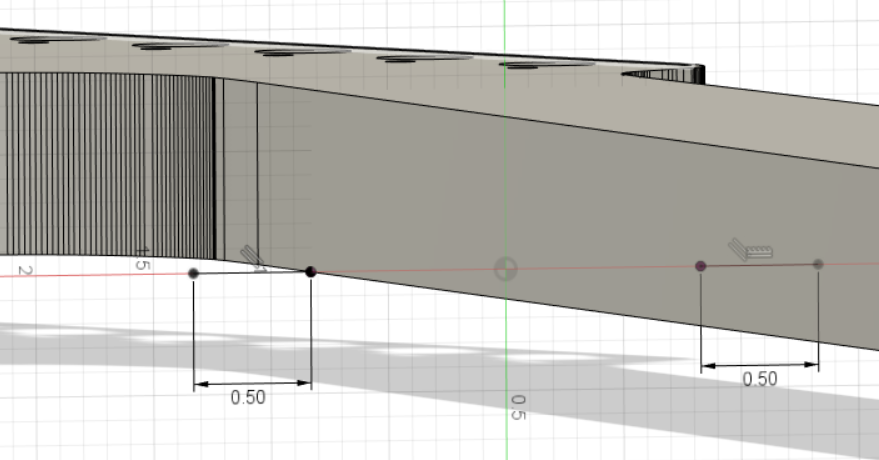
Create a new sketch on this workplane. This will be the cross-sectional area for the neck at the nut.

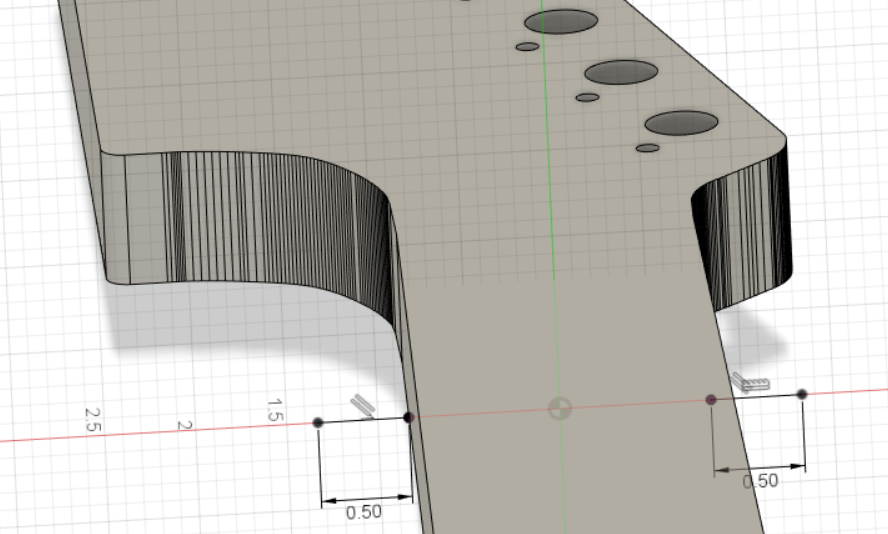
Now we will project the edges of the neck to help us get the curvature drawn correctly. Use the “Intersect” method of projection that will capture the lines that intersect the sketch/plane.



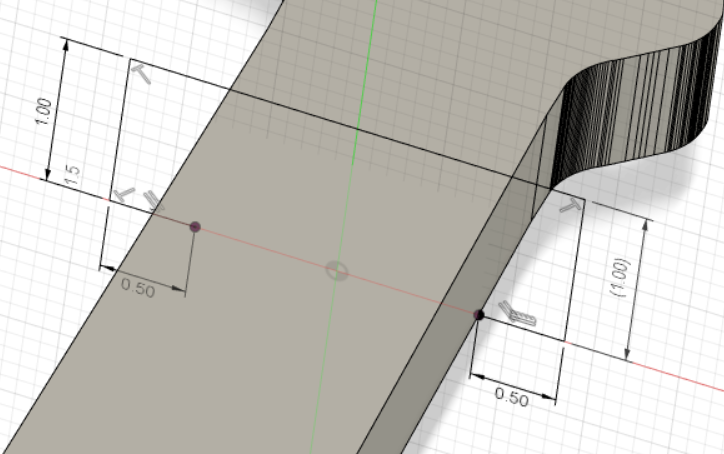


The two edges are shown in blue.

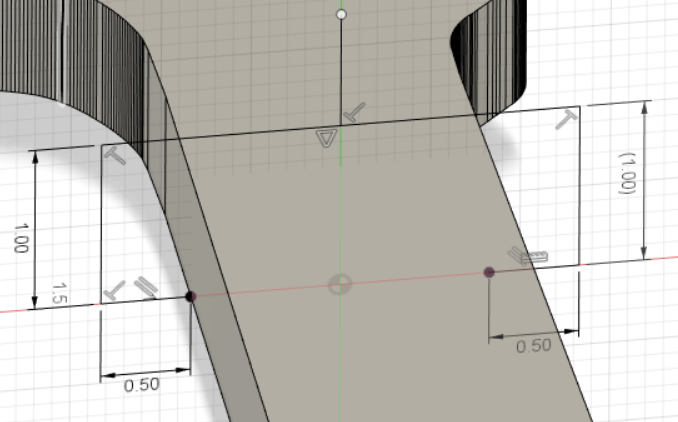
 



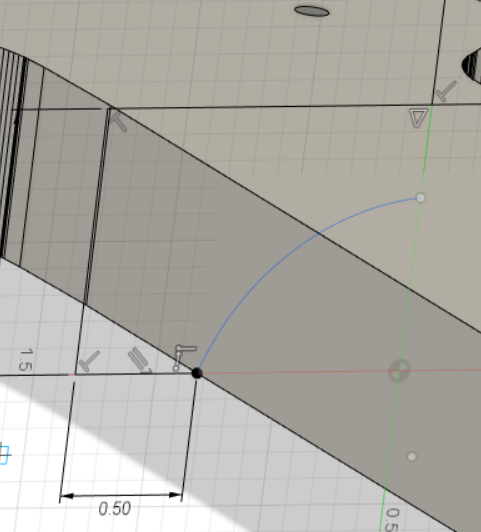
Draw a line outward from each intersection point, make the lines 0.5 inches long.



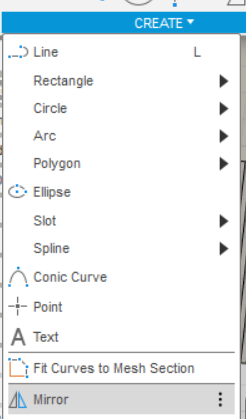
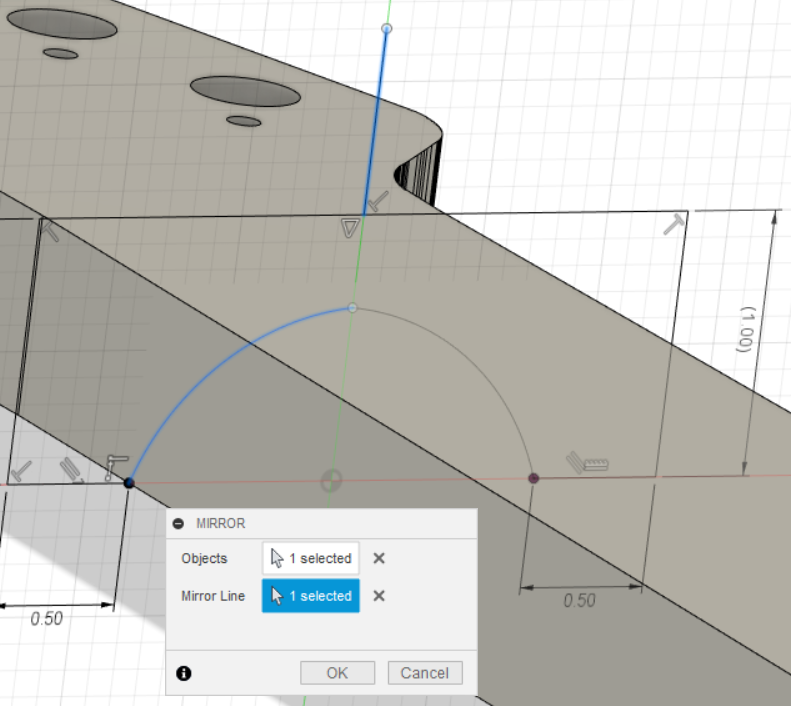
Draw up and over…



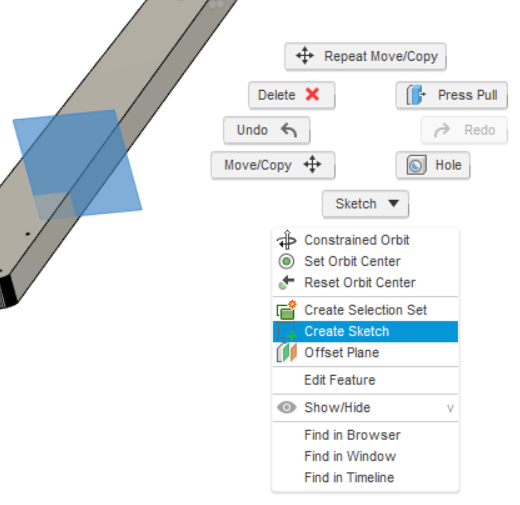
Draw an extra vertical line up from the mid-point of your top horizontal line. This will be for a mirror plane for the neck profile at the nut.

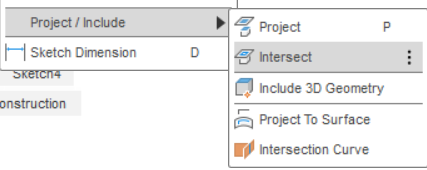
Draw a 3-point arc to define half of the profile. It’s okay to eyeball it.

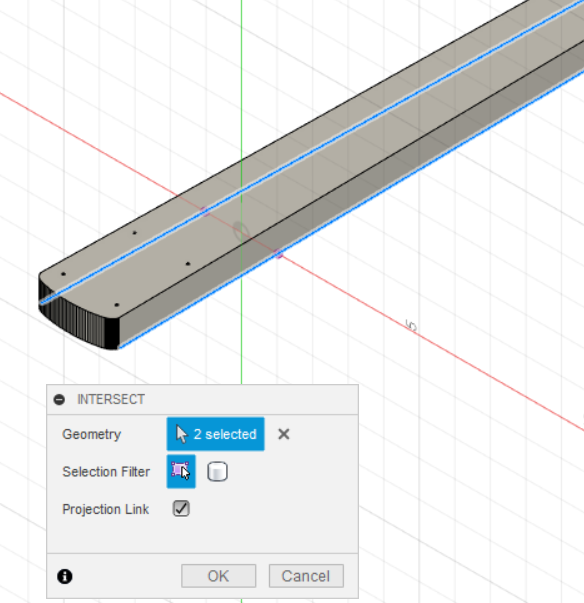
Now select Create🡪 Mirror. The curve is the object to mirror, and the extra vertical mid-point line is the mirror line. Click ok to finish the operation. This completes the sketch for the nut cross-sectional area.



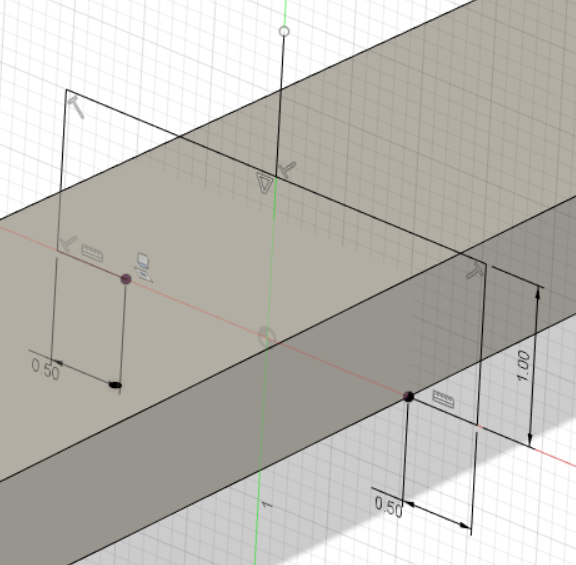
Highlight the workplane for the heel cross-sectional area. Right click🡪 Create Sketch.



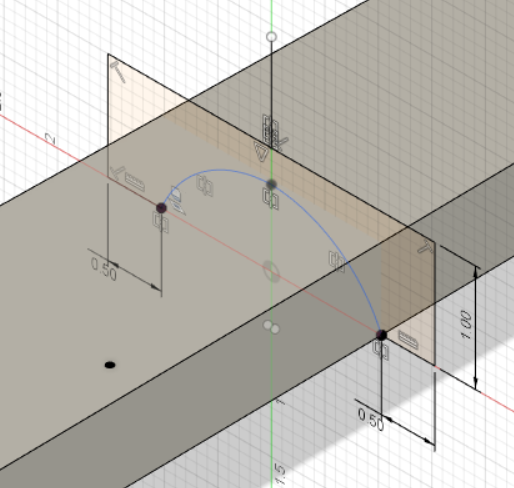
With the sketch created, go to Create🡪Project/Include and choose “Intersect.”



As before, select the two edges of the neck where the fretboard will be glued on (indicated in blue.)

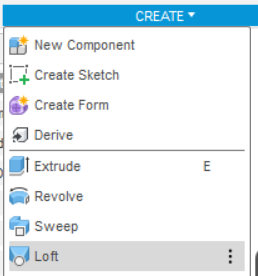


Draw the sketch similarly to how you did the nut CSA sketch

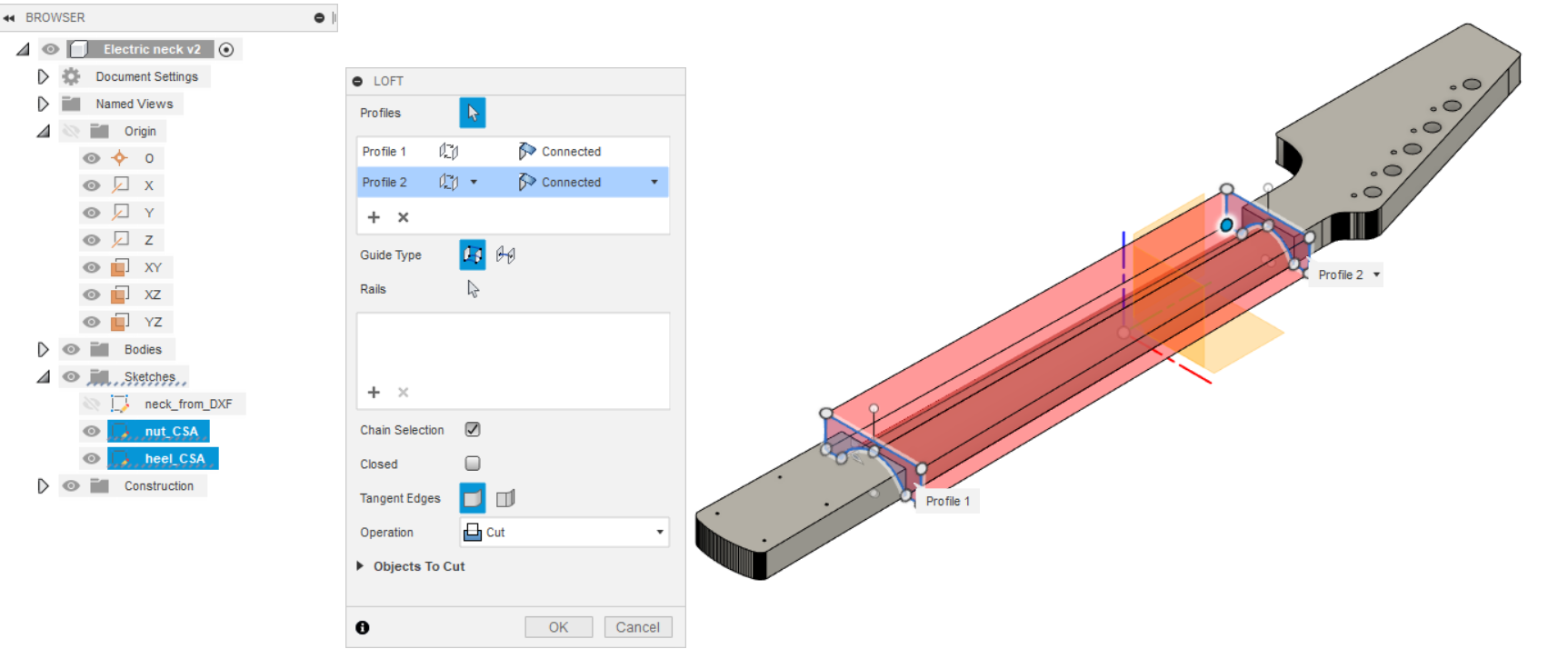


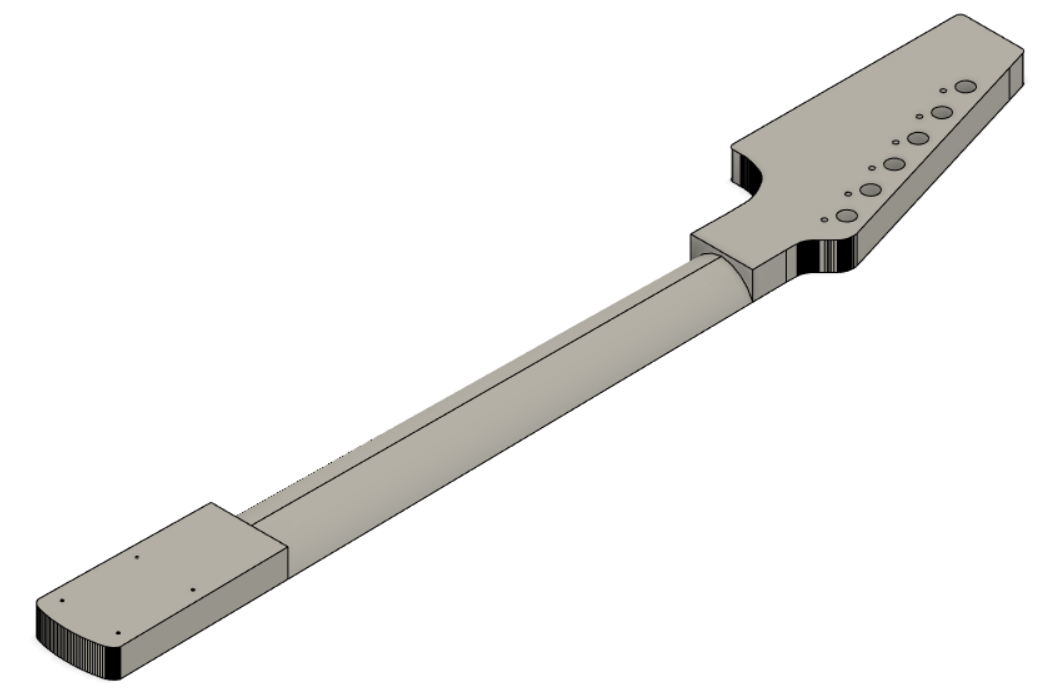
Add a 3-point arc for one half of the profile shape, and use the mirror command to complete the sketch.

With the two sketches completed, we can now create a loft that will give us the majority of the neck shape.



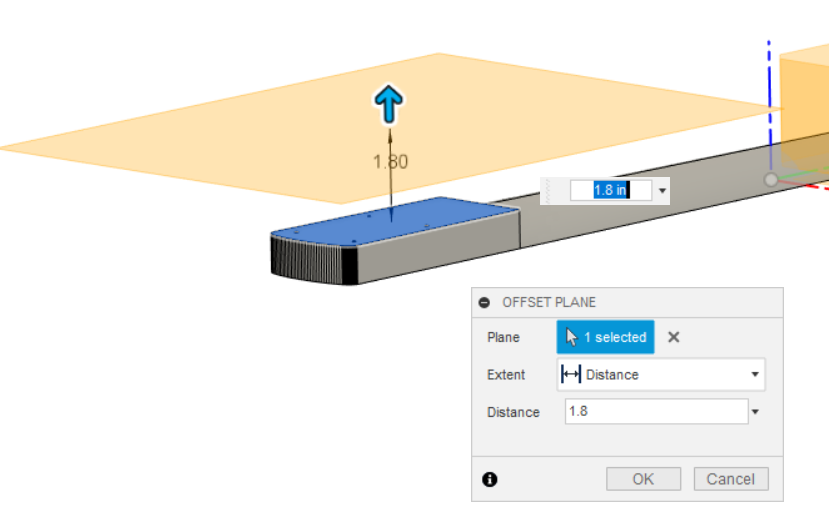
Go to Create🡪Loft. Select the two sketches

Make sure the two sketches are used for the profiles, and that the operation is set to Cut.

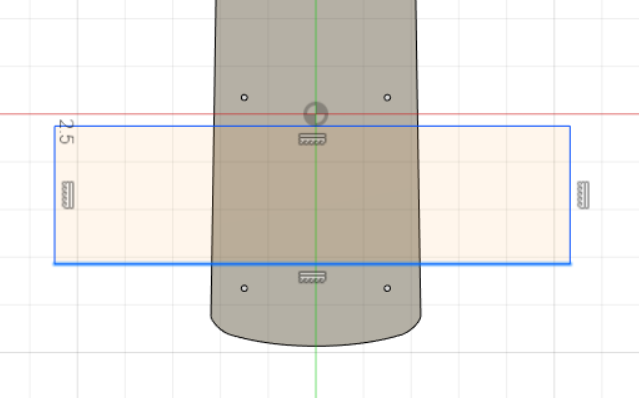
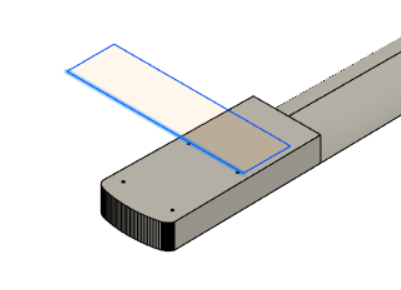


The neck after the Loft operation has completed.

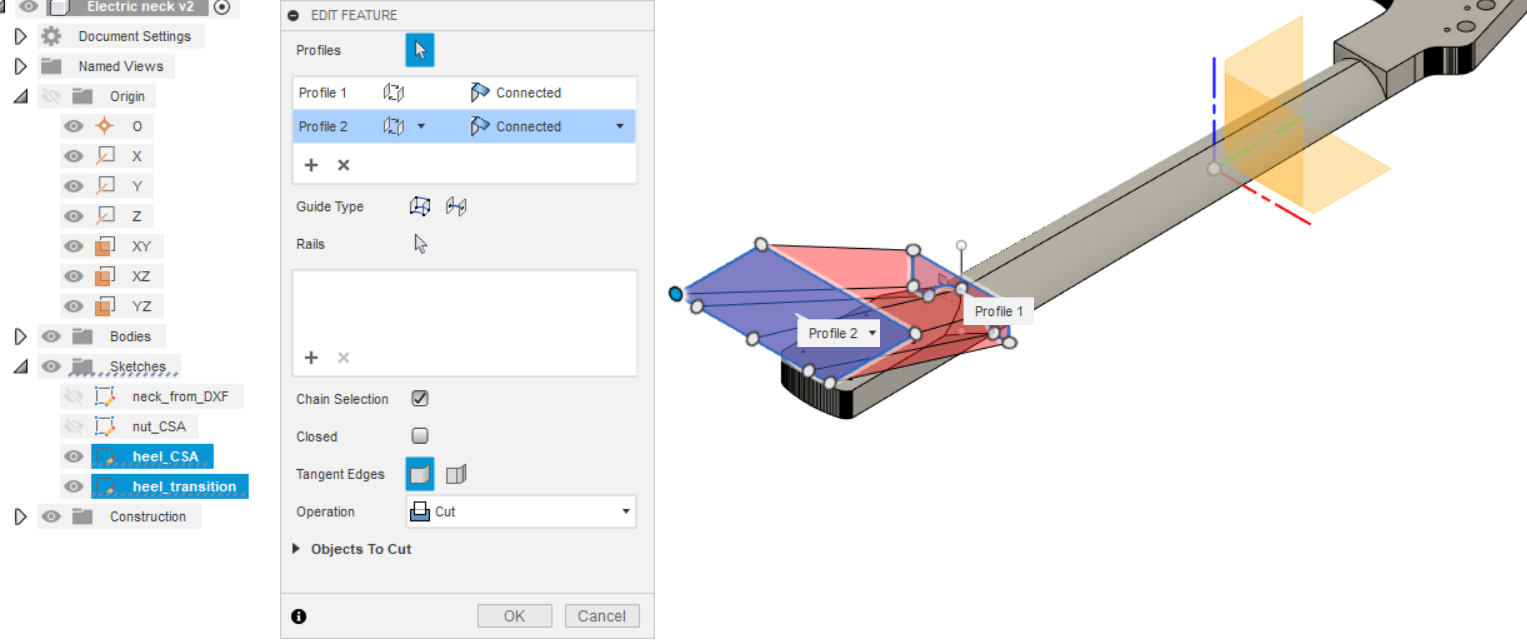
Next up, we need to make transitions at both ends of the loft. First we will create a sketch over the heel area to create a second loft. To begin, create an offset workplane to the top of the neck heel.



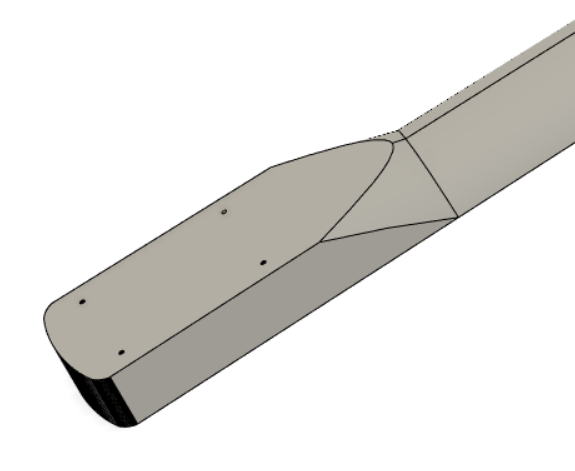
Use a distance of 1.75 to 2 inches to establish this workplane.

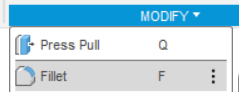
The sketch is placed and sized by eye, approximately 1.5 x 5.5 inches. Adjustments may be made after the loft is complete to alter the shape of the loft. The loft will be regenerated after closing the newly-edited sketch. After drawing the rectangle, it was moved further from the origin along the Y axis.



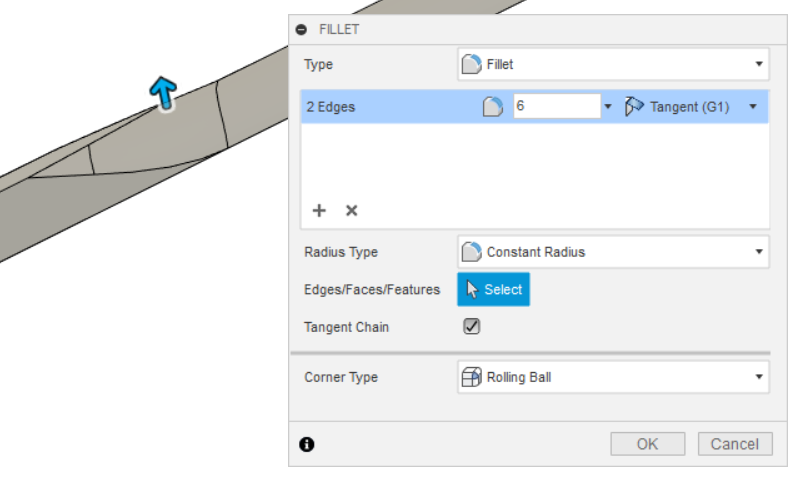
Use the transition sketch and heel CSA sketches for this loft, again, make sure the operation is set to cut.



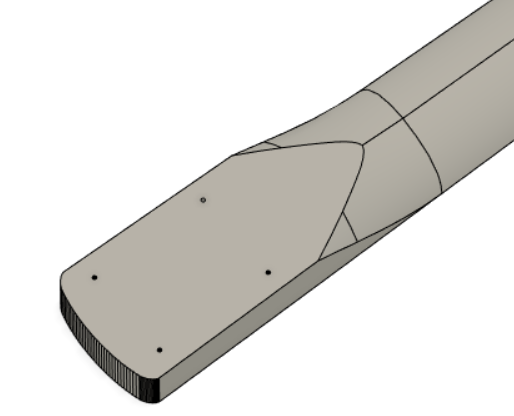
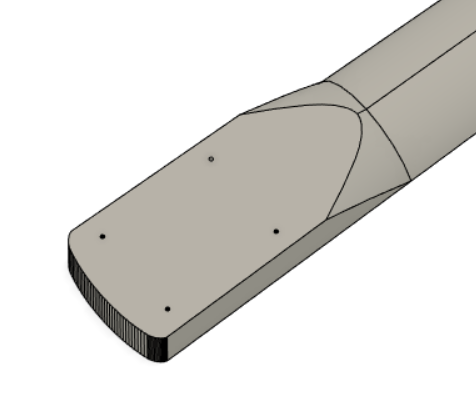
The resultant transition is not very smooth. We will use a fillet to smooth the crease at the transition.



Go to Modify🡪Fillet.

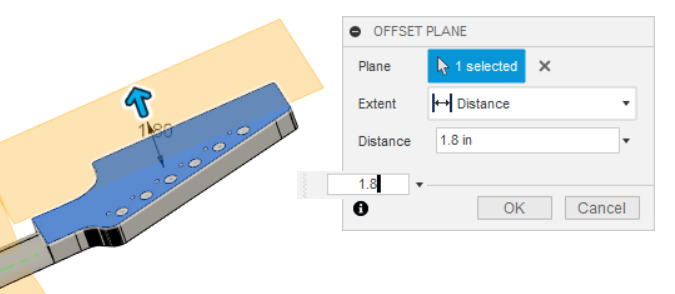


Select the crease edges on the treble and bass sides of the neck. Use a fairly large radius. Six inches looks good in this instance.

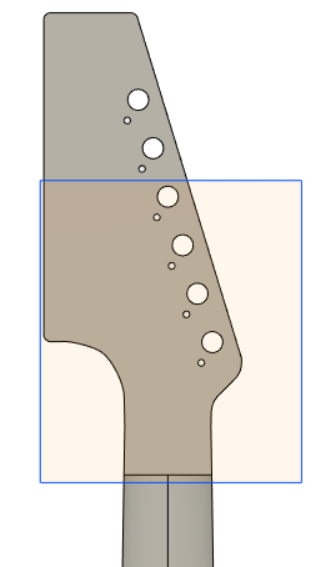


BEFORE AFTER

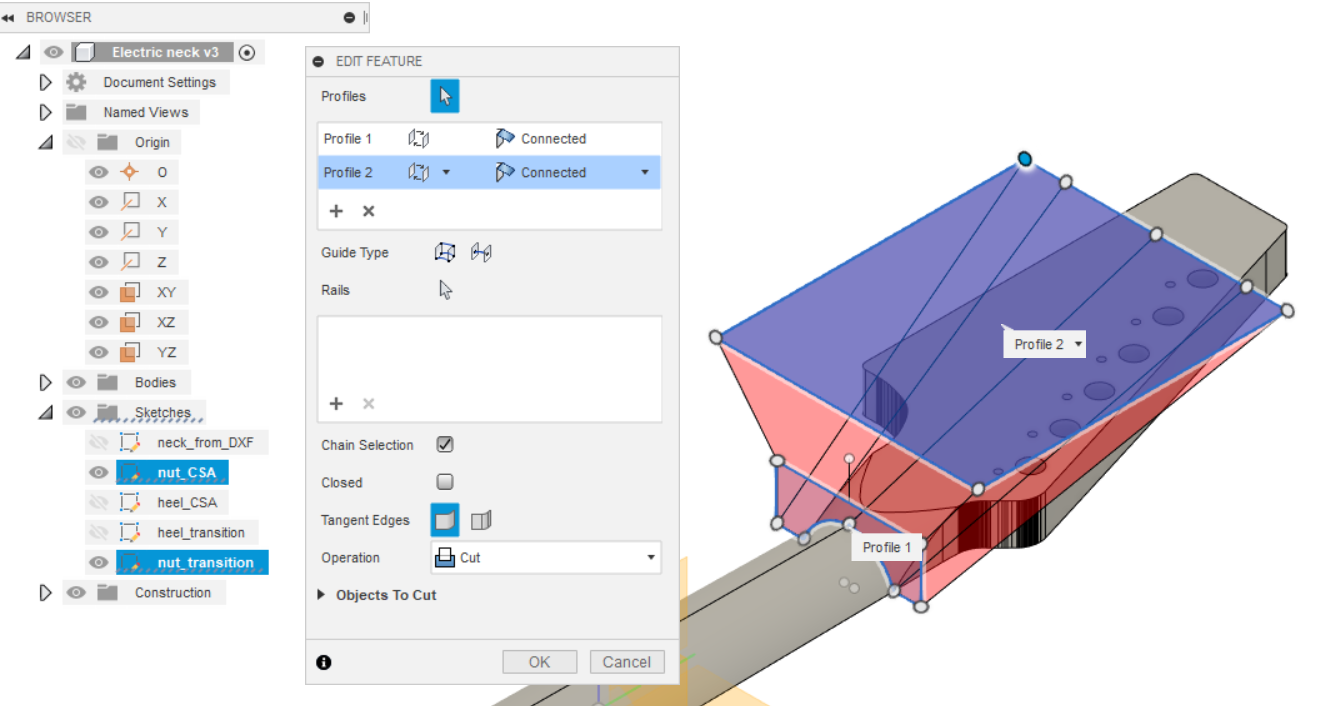
For the transition at the nut, begin by creating an offset workplane to the back of the headstock.



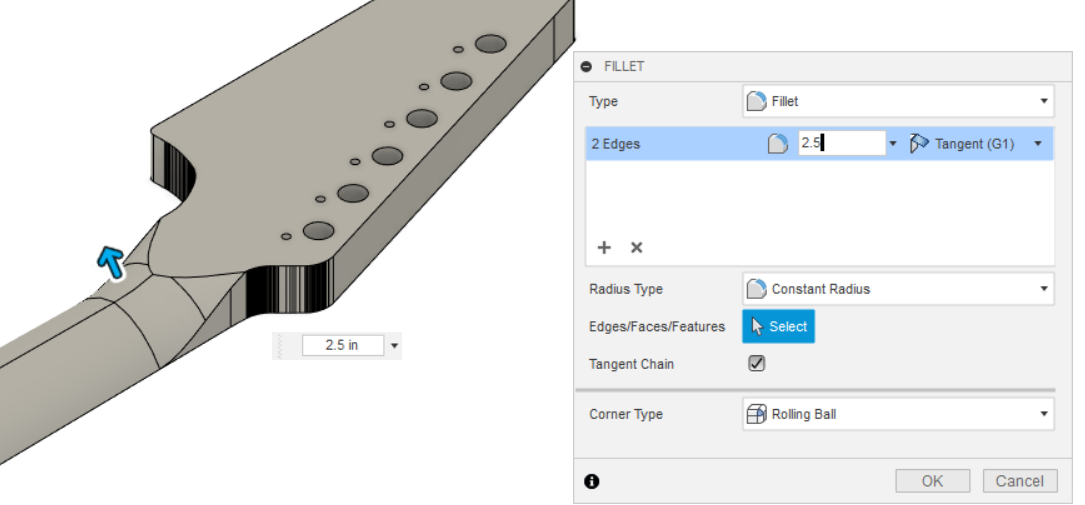
A distance of 1.75 to 2 inches is appropriate. It’s a good idea to use a different workplane than for the heel transition for greater flexibility in design modifications.



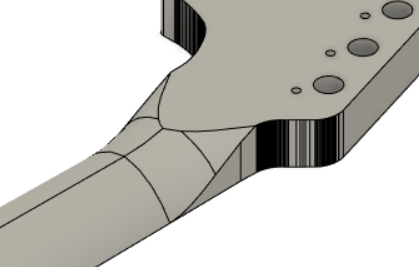
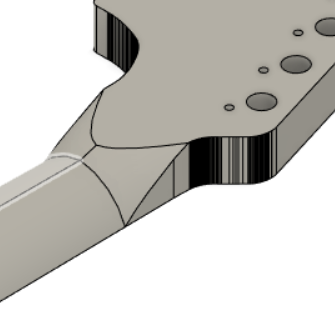
The size and location of the transition rectangle sketch can be tweaked. The goal is for the loft to not clip the rear of the headstock.



Select the nut cross-sectional area and transition rectangle as the two profiles. Be sure that the loft is set up as a cut operation.



Again, select the bass and treble edges left by the crease in the transition, and apply a fillet. A radius of 2.5 inches looks decent here.



BEFORE AFTER

More to come…

**Learning Objectives:**

**(List measureable objectives)**

**Standards:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Student Performance Objective(s):** | | | |
| **HS-ETS1-3** | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. | | |
| **Science and Engineering Practices** | | **Disciplinary Core Ideas** | **Crosscutting Concepts** |
| **Constructing Explanations and Designing Solutions**   * Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. | | **ETS1.B: Developing Possible Solutions**  ▪  When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. | **Influence of Science, Engineering, and Technology on Society and the Natural World**  ▪ New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. |

Common Core State Standards for ELA/Literacy:

**RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**RST.11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

**RST.11-12.9** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Common Core State Standards for Mathematics:

**MP.2** Reason abstractly and quantitatively.

**MP.4** Model with mathematics.

List The Common Core Math, Next Generation Science Standard and/or SME Competency Gaps. For example:

Need to find some standards. I’m thinking ITEEA STL, PLTW IED or PLTW CIM

**Materials Required:**

**Safety:**

**safetys:**

**References:**

**Activity:**

**Reviewing Faculty Cohort Members:**

* Include at least two names and schools of reviewing faculty cohort members (refer to email list for faculty cohort member email addresses). **Why do reviewing faculty get named but not the author?**