Chapstick Keychain

Brenden Koo | ME 127 | Winter 2023

1

Brainstorming and Ideation

Prompt interpretation, Intention, Sketches

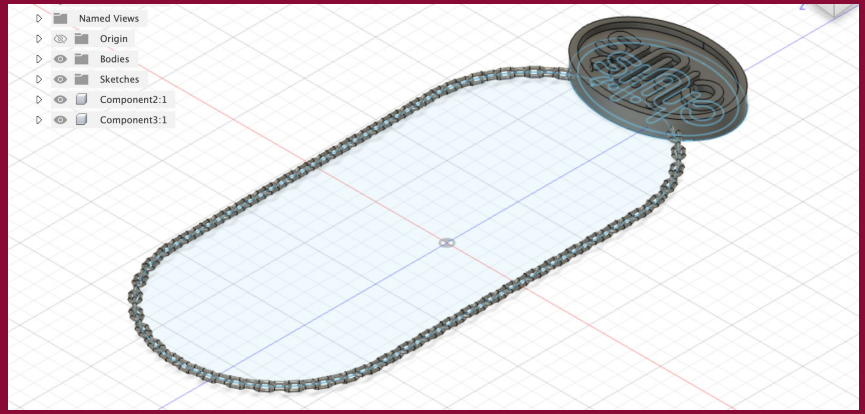
When I first saw the AM assignment, my understanding was that I needed to apply the additive manufacturing assembly techniques I learned in class. I initially intended to create a print in place mechanism, where one print would have two or more moving parts that could not be assembled if the parts would be printed separately–hence, the parts are *printed in place*.

From the second I read the prompt, I knew that I wanted to create a chain. I've seen people create 3D-printed chains, albeit with a lot of supports. I knew that I wanted to create a large chain necklace with a large pendant, even if it served a purely aesthetic purpose.

My initial CAD design

Concerns

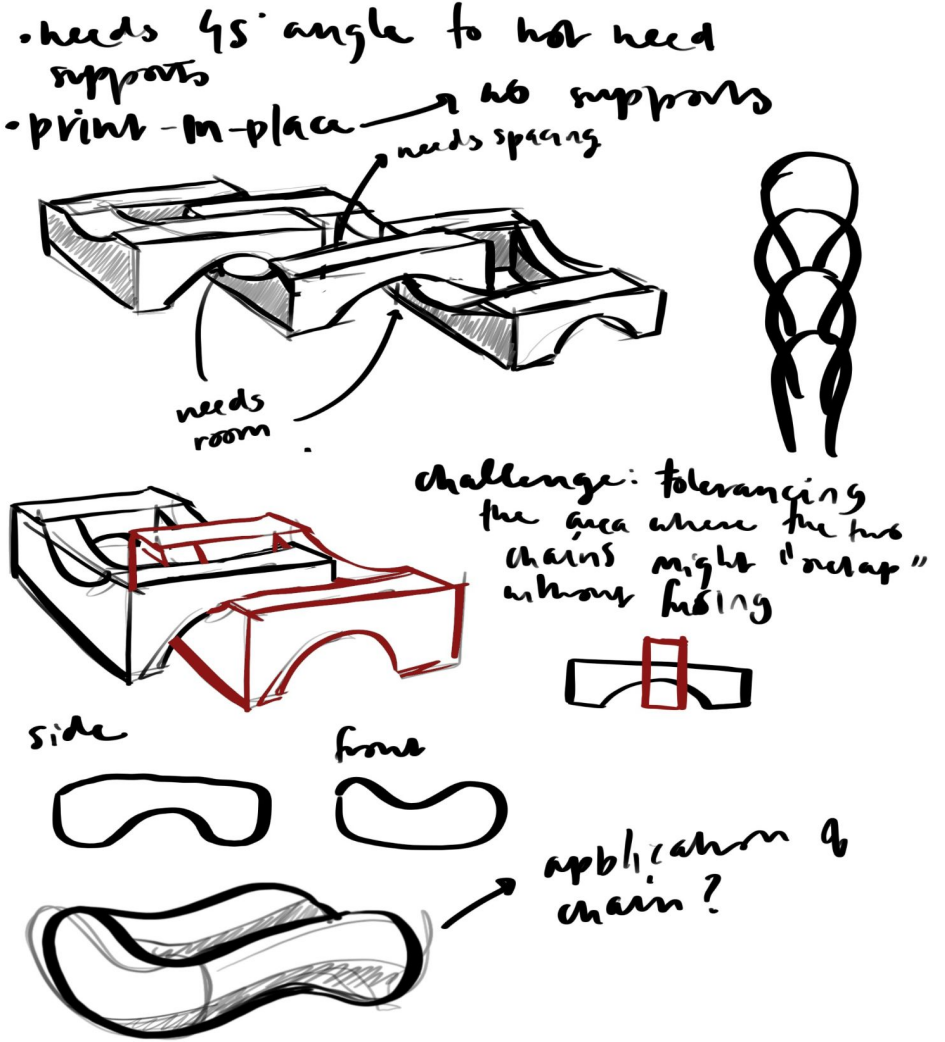
I was already wary of the fact that a chain would serve a purely aesthetic purpose, something I have been trying to move away from as a designer. Furthermore, I realized that the build plate was not large enough to print a chain necklace, and it would be a lot smaller than I had anticipated. I realized that this was the moment to pivot my design.



After talking to Dan, he showed me a chain design that requires zero supports, and challenged me to take my design to the next level. I was inspired by the design, but wanted to create a unique design of my own.

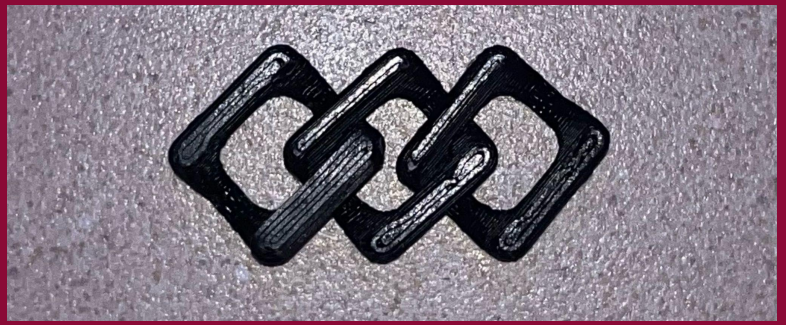
Revision

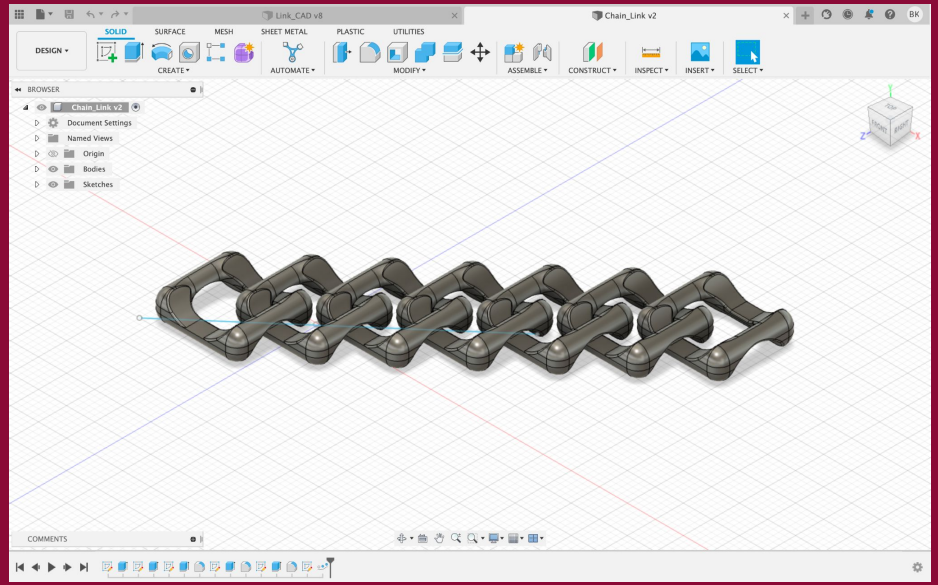
I realized that I could create a 3D printed chain without supports, so long as the links that overlapped one another were created with a 45° angle, so that there is always something for the print nozzle to lay the PLA over.



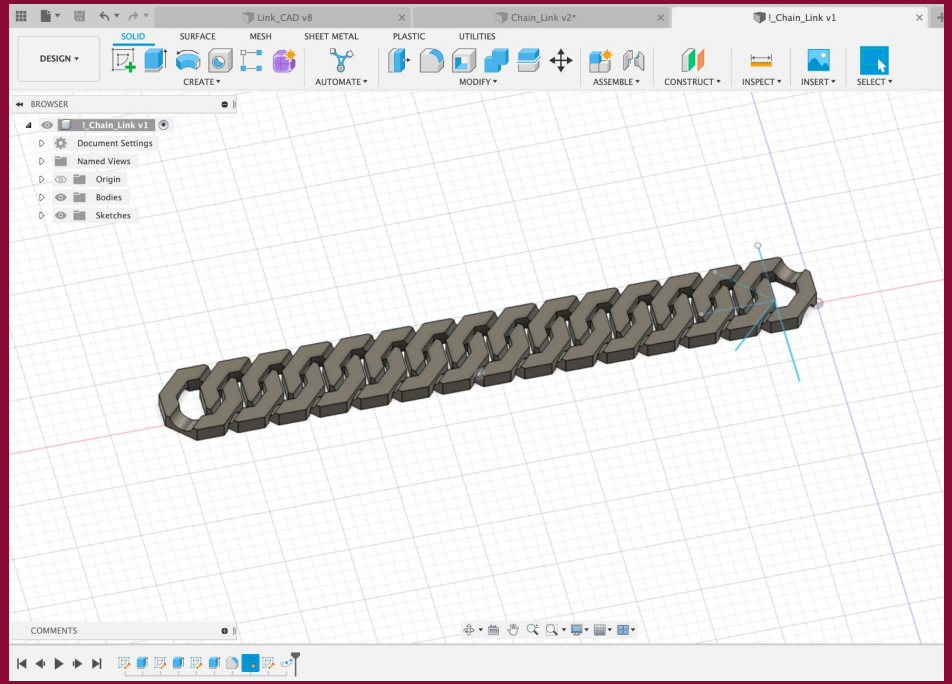
Revised Chain

I created the CAD model (right), where the design supposedly did not need supports. The print (with three links) was a success:





Revised Chain



I actually thought that my chain design I printed was quite ugly. I changed the chain design once again, relying less on fillets and chamfers and opting for a cleaner look, as demonstrated to the left.

This design was also a success!

I tried printing the chain itself, and it was a success. Although I had to break some of the pieces apart, the chains did not fuse together, and it moved pretty flexibly and freely. After fashioning (forcing) two found jump rings into some of the holes, I realized I could make a keychain.

I now had a chain design, but no purpose. I couldn’t make a necklace or even a bracelet, since the design reduced the chain flexibility. I then thought:

I always lose my chapstick.

I wanted to create a product to change this

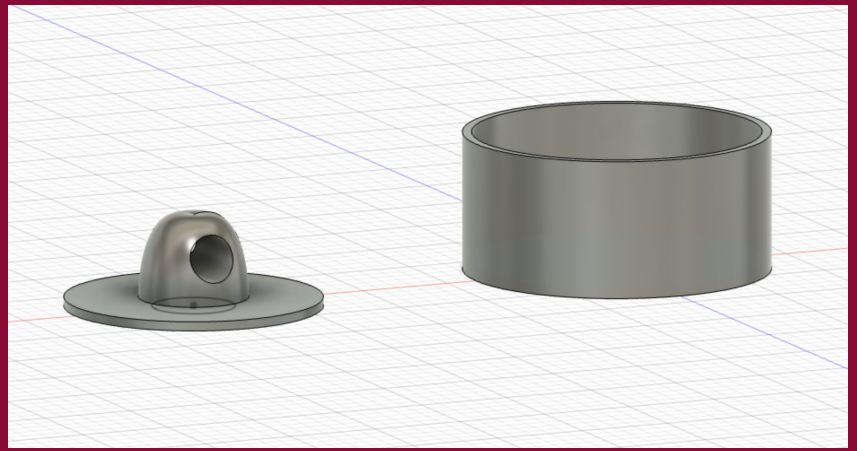
2

Iteration

CAD, Design Realization, Final Prototype

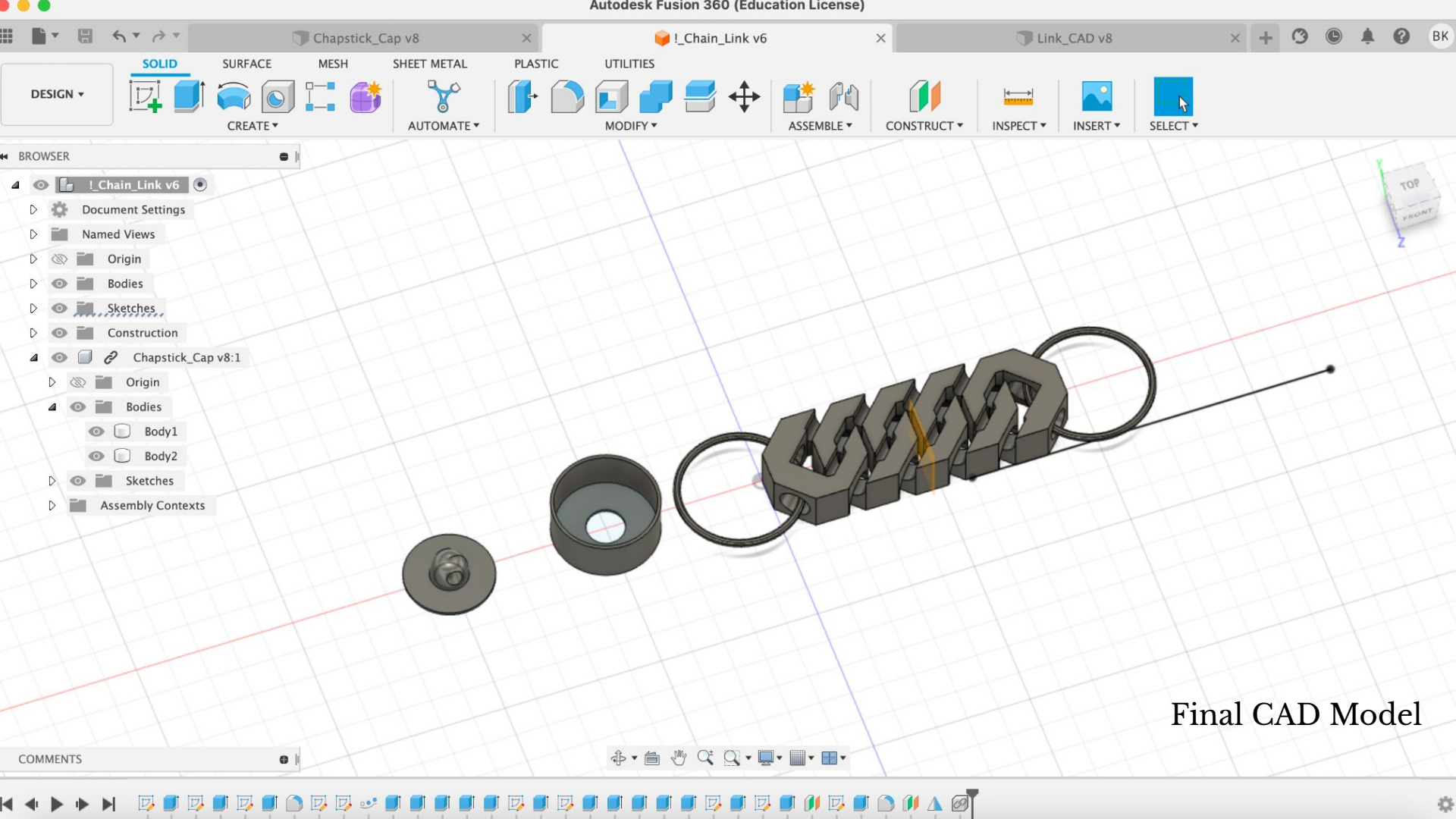
Chapstick Holder

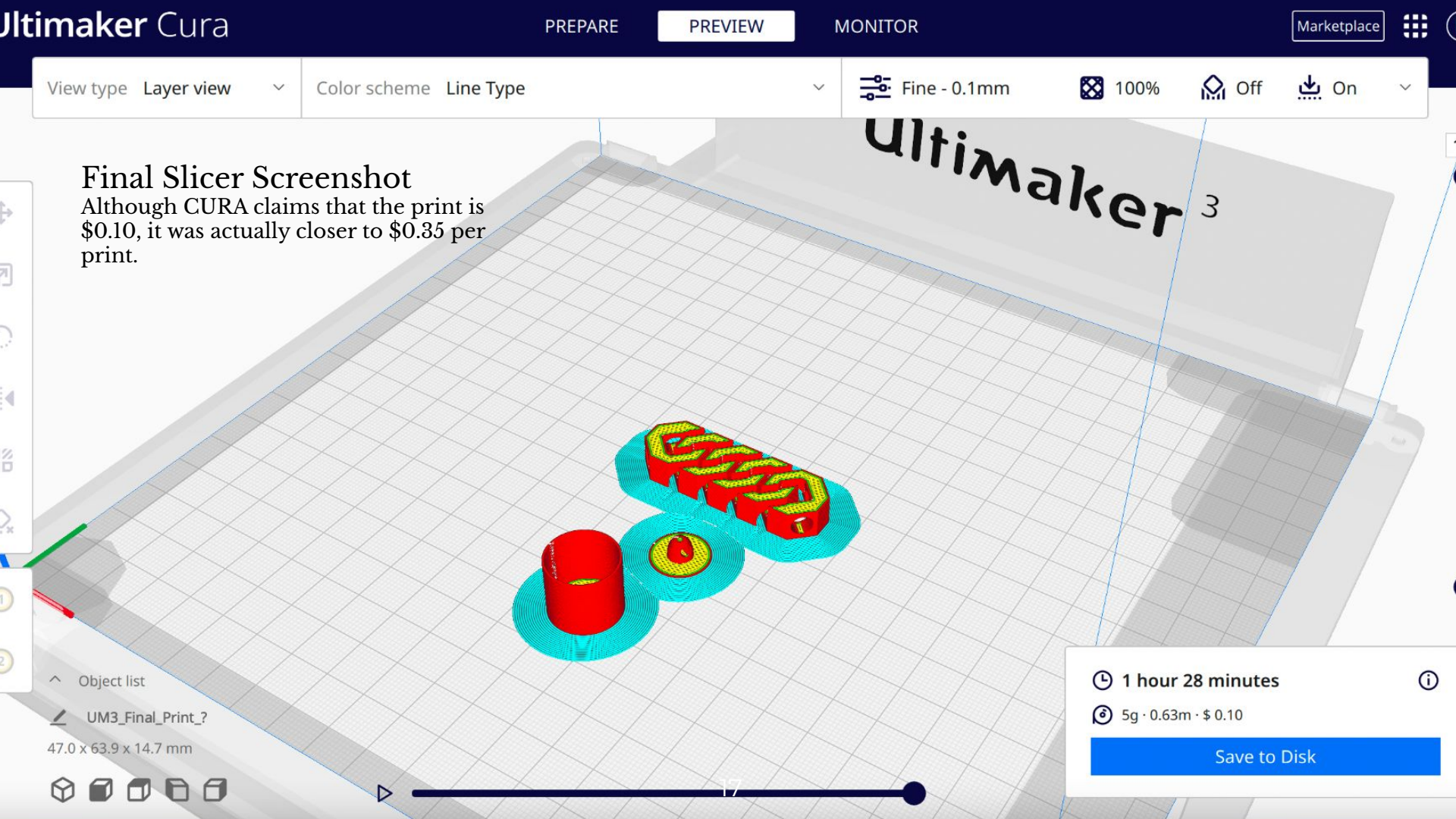
To design something that would hold my chapstick, I needed to determine how the chapstick would be attached to the chain. I decided that with the Jump Rings, I could create a form-fitted cap to be secured to the chapstick, with a through-hole in the cap for the ring to fit through.



Form-Fitting Process

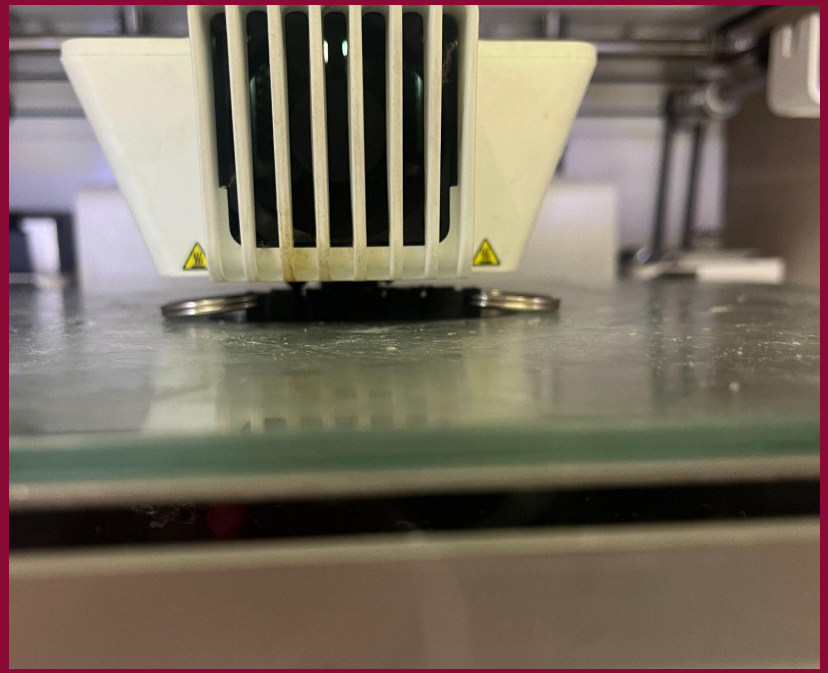
In order to create a form-fitted cap, I needed to use calipers to measure the diameter of the cap, but add a little bit to the dimensions to account for tolerancing differences when the design is set to print. After a number of test prints, I determined the perfect diameter to implement for the design.


Autodesk Fusion 360 (Education License)
Chapstick_Cap v8
!_Chain_Link v6
Link_CAD v8
SOLID
SURFACE
MESH
SHEET METAL
PLASTIC
UTILITIES
DESIGN
CREATE
AUTOMATE
MODIFY
ASSEMBLE
CONSTRUCT
INSPECT
INSERT
SELECT
BROWSER
!_Chain_Link v6
Document Settings
Named Views
Origin
Bodies
Sketches
Construction
Chapstick_Cap v8:1
Origin
Bodies
Body1
Body2
Sketches
Assembly Contexts
COMMENTS
TOP
FRONT
Final CAD Model


Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
View type Layer view
Color scheme Line Type
Fine - 0.1mm
100%
Off
On
Final Slicer Screenshot
Although CURA claims that the print is $0.10, it was actually closer to $0.35 per print.
Ultimaker 3
Object list
UM3_Final_Print_?
47.0 x 63.9 x 14.7 mm
1 hour 28 minutes
5g · 0.63m · $ 0.10
Save to Disk

I sent the design to print via the Ultimaker, using Tough PLA because I did not need to model to be exceptionally strong. I needed something that would print relatively quickly, and would withstand a normal amount of force.

Dan had found some keyrings in Room 36 that I could use, but they were a bit stiffer than I had expected. A solution to this problem was to implement a mid-print insert into my design. I paused the print midway through the process, gingerly placed the keyrings into the appropriate holes, and continued the print.



Final Design

I am extremely proud of my final design, as it serves its purpose (and I can keep track of my chapstick!) If I had extra time to continue iterating my design, I would make one change with the chapstick cap.

Currently, the chapstick cap is form-fitted, so I would have an extremely difficult time removing the chapstick from the cap (which is good and bad). If given more time, I would design something that is equally secure but allows one to easily swap their chapstick when one runs out. However, since the chapstick cap is not integral to the assignment prompt, I am satisfied with the current design.

3

Reflection

How did I do, and How can I move Forward?

My design was successful! I designed a print in place chain that did not require any supports. The chain was properly dimensioned so that the links did not fuse with one another. I also implemented a mid-print insert, using two of the three proposed additive manufacturing assembly techniques.

As mentioned earlier, if given more time, I would take more time to design a better way to secure the chapstick to the keychain. Currently, I have implemented a form-fit cap, which makes it extremely difficult to swap the chapsticks. If I had more time, I would design either a pouch or container that would streamline and simplify the process of changing chapsticks. Otherwise, my design was extremely successful!

Reflection

I am very pleased with the outcome of this second project. I initially started off with a simple yet incomplete idea of how I wanted to approach the prompt, and I admittedly had moments in the design process during which I questioned what I was going to do. However, it was the support of the CAs and Dan around me who encouraged me to continue along the path that I had intended, but to broaden my perspective to observe new challenges–creating a chain without supports–and tailor my design to my interests–chapstick (my lips get chapped so quickly)! I'm glad that I started off simply and allowed my designs to inspire the process, and I am extremely happy with the final product!

Admittedly, I do wish that I had a more defined (not necessarily complete) image of my final product before I started prototyping, so that my iterations were not as aimless. In the future, I may alter my approach by developing more fully-fledged sketches and brainstorms, rather than just jumping into the first design idea that comes to mind. Although "a chain" was a great launch point for my project, I should have thought a bit more critically about the direction this "chain" could evolve in.

Bill of Materials | Estimate of Total Time: ~17 hours

Item	Cost
Test Print Tough PLA - Black	$0.06 + $0.33 + $0.7 = $0.46
Final Print Tough PLA - Black	$0.35
KeyRings (graciously provided by Dan (thanks Dan!))	$0.00
Total	$0.81