Annotated Bibliography

1. Qi, Yu, et al. “A Review of Structure Construction of Silk Fibroin Biomaterials from Single Structures to Multi-Level Structures.” Edited by John G. Hardy and Chris Holland. *International Journal of Molecular Sciences*, vol. 18, no. 3, 2017, p. 237. *PubMed Central*, A Review of Structure Construction of Silk Fibroin Biomaterials from Single Structures to Multi-Level Structures - PMC.
2. I found this source useful because it discussed the possible uses for a chemical that our team is thinking about using for our experiment. “Silk fibroin” is a chemical that we’ve seen mentioned before in another procedure involving spider silk. It seemed to be an essential piece of information that we could use for our solution as well. This resource on PubMed confirmed additional uses and benefits of silk fibroin; It’s very biocompatible, it can degrade at a rate that scientists can set, it has a sufficient supply and so much more. It spurred further exploration and we’ve considered contacting other researchers because of it.
3. Presti, Marco Lo, et al. *Dynamic Adhesive Fibers for Remote Capturing of Objects*, 24 Sept. 2024, Dynamic Adhesive Fiber.

This research article comes from a team of scientists at Tufts University Silk lab. The article closely details the procedure required to form an adhesive fiber, similar to that of Spider-Man’s webbing. He lifts various objects using the fibers to demonstrate their tensile strength, which is likely what we will do once we’ve created the fiber. At first we were only able to read the abstract of the research paper, but after contacting one of the researchers of this project, Fiorenzo Omenetto, he gave us access to the entire research paper. This included the introduction, results and discussion, conclusion, and experimental section, along with the various images that are implemented throughout the paper. This source is

key to our capstone project's completion because it gives us a step-by-step lab procedure to create the polymer necessary for our capstone.

4. **REAL Web Shooter (Spider-Man: No Way Home)** (Creates, Joel, *REAL Web Shooter (Spider-Man: No Way Home), October 29, 2021*)

This video had an interesting take on how web-fluid could be approached. The creator, Joel Creates, made a web-fluid out of hot glue using heating coils and CO2 cartridges. The CO2 cartridges idea was initially Trent's idea all he way back in sophomore year during our first iteration. This Youtube video most likely reminded Trent about his initial idea, it's something to consider when thinking about alternative routes to approach our project. Considering we've had more questions about logistics and scope than actual science based questions it's important to take into consideration any other options, or as our mentor says, "off-ramps" that our project could take if something goes wrong. For example if a chemical doesn't give the desired reaction or god-forbid doesn't show up at all we need to switch to something else fast. These types of videos could be a very good way to find ways to pivot in case of an emergency.

5. Xu, Zhe, et al. "Construction of high-strength, super-adhesive conductive hydrogel based on dopamine-modified carboxymethyl cellulose under the multi-effect of iron ions." *European Polymer Journal*, vol. 220, no. 113428, 2024. *Science Direct*, https://www.sciencedirect.com/science/article/abs/pii/S001430572400689X#:~:text=Dopamine%20is%20frequently%20used%20as,from%2015%20to%2040%20kPa.

One of the ingredients on our radar was dopamine. In the article written by Omenetto, dopamine was used as a modification that would add an adhesive trait to the solution along with the fibroin that was extracted from the silkworm. This source corroborates the

idea that dopamine could be used to modify chemicals and give it an adhesive kick. The application of adhesive property was used in a more practical and more applicable way for most tech companies. They used dopamine to modify a hydrogel that was used to make a microsensor stick to the microchips that it was set up for.

6. Dopamine Self-polymerization (Fichman, Galit. "*Dopamine Self-Polymerization as a Simple and Powerful Tool to Modulate the Viscoelastic Mechanical Properties of Peptide-Based Gels.*" *National Library of Medicine*, MDPI.com, National Library of Medicine, MDPI.com)

- This research article dives deeper into the science behind how dopamine polymerizes on its own. While it's not the most helpful source we have it does give us some greater insight into the thought process behind dopamine, since we will be using it in our experiment. It provides greater confidence for us, though, there is a lot of science jargon that we are not advanced enough to understand, which makes the article really incoherent for us. One thing to note is that dopamine can undergo oxidative self-polymerization to yield polydopamine, a robust universal coating material, so I wonder if we perform this process in our lab, when mixing with the silk, will it allow for a stronger polymer to be created? We'll have to do more research.

7. How to use a CO2 tire inflator

- It's important that we understand every part of our web shooter closely before just slapping things together. We plan on implementing a CO2 bike inflator as a way to pass highly compressed air from a CO2 cartridge, which will then go into a pipe, through a quick-connect-fitter that the cartridge filled with our webbing is attached to. Getting a better look and understanding as to how the bike inflator functions and its relation to the CO2 cartridge. The issue this source brings to my attention is that we cannot shoot the CO2 cartridge vertically, just using the inflator, therefore we will need to find a way to

transport the pressurized air from the CO2 cartridge to the web cartridge. This could possibly be done through looping everything (rectangle).

8. Making REAL Spider-Man Web Shooters & Web Fluid | A Comprehensive Progres… (Schizo. “Making REAL Spider-Man Web Shooters & Web Fluid | A Comprehensive Progress Update.” *Youtube.com*, 8 July 2023)

- This is another video where only a certain is important for our capstone research, which is from six minutes and twenty seconds to seven minutes and twenty seconds. This seems like the simplest design for the web shooter, in both storing the web (which in his shooter is lighter fluid cartridge), and shooting it. I do think that Julian and I do not have enough experience in 3D printing (specifically modeling a design on a computer) to make the web shooter he does. I wonder, though, if there is a way to create the web shooter through more practical means, instead of the advance method he uses.

9. Research Article for Web (Omenetto, Fiorenzo. “Dynamic Adhesive Fibers for Remote Capturing of Objects.” Advanced Function Materials, 2024)

- This is truly the heart of our webbing, and in turn our project. The entire procedure of how we make our webbing is outlined here, but we don’t need sodium carbonate and lithium bromide, since we won’t be obtaining actual silk cocoons that we will need to dissolve to isolate the regenerated silk fibroin protein. The fusion of silk fibroin and dopamine are the main components, which leads me to believe that dopamine might be a little more than meets the eye. PMMA powder may also work for our beta-testing, which involves our original polymer web. Will need to find access to a real lab that has a centrifuge, along with other specific types of syringes. For the most part we can do this experiment, once given the materials needed, in a lab at SLA.

10. Making Spider-Man's Web in real life (IRL, Built. “Making Spider-Man's Web in Real Life.” *Youtube.com*, 30 April 2021, Making Spider-Man's Web in real life)

- Out of the 9 minute video, the only part worth looking into is from the 1 minute and twelve seconds mark to the three minute mark, which is where he chemically creates a web-like (in appearance) polymer. He uses less materials than we are currently planning on using, and although his polymer is weak and fragile, I believe it is possible to strengthen, possibly using dopamine. This may also be a confirmed possibility once we confirm the successful completion of our beta-test. This is one of three possible polymers we could create, but this one seems to need the most fixing.