

#### Section IV: Discussion

In terms of the compression test results for each of the differing alginate samples, Young's Modulus was extracted from these results. Young's Modulus is a measure of the elasticity of a material and is found by calculating the slope of the linear section of a graph. A steep slope indicates a stiffer material, while a small slope indicates a weaker material, low in mechanical properties. As seen in the case of the 5% alginate solution with 0.5 grams of gelatin, it had the steepest slope indicating it was the stiffest material. In other words, it could withstand the most amount of weight without crumbling, ultimately improving the overall mechanical properties of the alginate hydrogel. However, when tested on the brown planaria, it was found that the 3% alginate solution with 1.5 grams of gelatin proved to heal the planaria the fastest, improving the overall recovery rate. This meant that its healing properties not only encouraged wound healing but also expedited this process when compared to the pure 3% alginate solution.

This work fits into other studies in the sense that alginate hydrogels have been tested in a variety of ways to improve wound healing, as well as the topic of testing on brown planaria. However, despite these similarities, the additions of gelatin and silica have not been necessarily tested with alginate, as well as the procedure conducted on the brown planaria (Abbasiliasi et al., 2019). In terms of the planaria, they are typically cut in half and then watched for regeneration, however, this project made an incision and watched for this process, as well as let them sit in the solution for thirty minutes and then moved them to spring water (Xu & Chisholm, 2014). This research could help advance the understanding of the field of biomedical science, as it has the potential to open a whole new world to alginate wound dressings. Given their low mechanical properties now, they are not preferred to use, however, with the addition of nanoparticles like gelatin and silica, the possibilities for these products are endless.

## Future Research

Future research of this project would include testing all the solutions that were created to not only expand the testing size but also get more varied data information. In addition, testing different nanoparticles would be beneficial to further improve upon the strengthened mechanical properties of this project. These future studies would not only broaden the realm of bandages and wound dressings but also give way to other biodegradable options to reduce plastic pollution.

## Section V: Conclusion

Overall, an alternative to polyethylene bandages that were biodegradable to reduce plastic pollution, strong enough to withhold usage, would reduce bacterial infection and could lead to a more rapid recovery was tested. Utilizing a lyophilizer to freeze-dry the samples and a universal testing machine to conduct compression tests, the samples were then tested on brown. In the end, it was discovered that the 5% alginate solution with 1.5 grams of gelatin had the highest compressive strength, while the 3% solution with 1.5 grams of gelatin proved to have the fastest recovery rate for the planaria. In a wider scope, the planaria placed in the pure alginate solutions took on average 2 days longer for their incisions to completely heal in comparison to the ones with gelatin additions. This was due to the enhanced wound-healing properties of gelatin, with the additional benefit of the higher mechanical properties that it provided the solutions with. With alginate having relatively low mechanical properties originally, this was the major deterring factor in its usage in comparison to polyethylene bandages. However, with the now increased mechanical properties, these hydrogels served as an adequate material to replace the absorbent pads on typical bandages. In addition, to minimizing bacterial infection and leading to a faster recovery time, these free-dried hydrogels were applied to a biodegradable bandage once testing was complete. This allowed for a rough prototype of this product,

as well as a physical item because of this entire project. Holding the key to changing the world of wound dressings as we know it, alginate is just the beginning of the mission to save our planet.