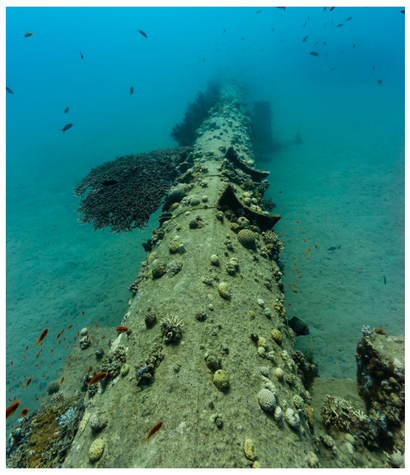
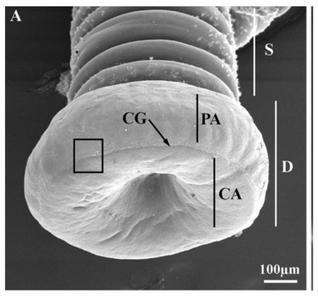
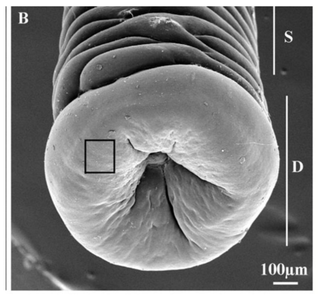
Problem:

As of right now about 50% of United States underwater oil and gas pipelines are over forty years old. These older pipelines are more prone to damage and corrosion as due to their reduced durability and outdated structure. Moreover, the pipelines are located in deep, murky and dark regions in bodies of water. The particles in these waters absorb and scatter sunlight leading to minimal visibility near the pipes. Due to these conditions, the ruptures and damages to these pipes are hard to locate and amend, leading to water pollution and endangerment of marine life.







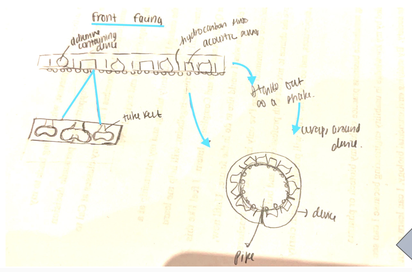
Inspiration:

Our product is inspired by the adhesion mechanism used by two species of Echinoderms, sea urchin *Paracentrotus lividus* and sea star *Asterias rubens*.

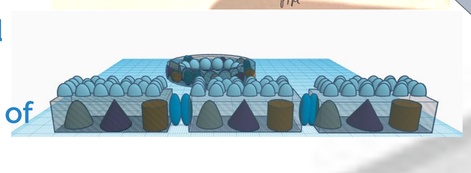
Echinoderm species can attach to rough substratum strongly and temporarily by means of tube feet disc flexibility. The discs can deform to fit the substratum profile so that the adhesive can be released evenly, allowing the organism to stick to very irregular surfaces. To detach, the organism simply secretes de-adhesive at interface between disc and adhesive.

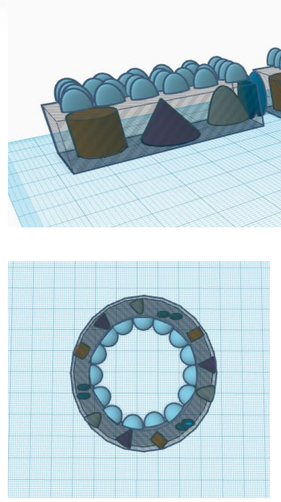
Solution:

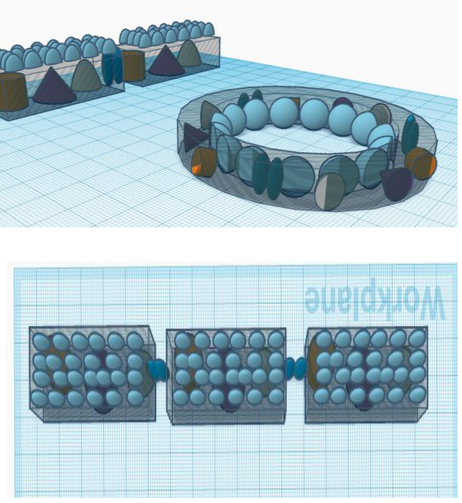
Following principles found in the adhesion mechanism of echinoderms, we constructed Aqua with viscoelastic structures that secrete biodegradable adhesive and de-adhesive to move along the pipeline. This allows the robot to be sturdy in waves, currents, or external factors that might otherwise cause the robot to fall off the pipe



Additionally, we will add hydrophone/ acoustic sensors and direct hydrocarbon leak detection systems to allow for effective targeting of damaged pipeline regions. In the case of an oil spill, Aqua's sensors can find the leak location and provide adequate inspection and maintenance, operational control and monitoring, and optimal functionality in murky waters.







Next Steps:

-Use Narrow-beam laser technology.: this lunar laser communication tech can move data at MB-to GB/sec transfer rates over in turbid waters. This can help us to improve the method for detecting pipe leakages.
Collaborate with UCSD professor Joseph Wang, who printed thick-film electrochemical sensors directly on flexible material (can be pushed and contorted under water). We can use this material to build Aqua.