

Reduction of Plaque Within The Arteries Through Nanoparticles

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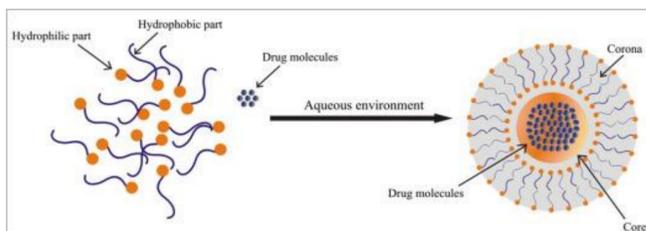
USC Viterbi Department of Biomedical Engineering, SHINE 2020

Introduction

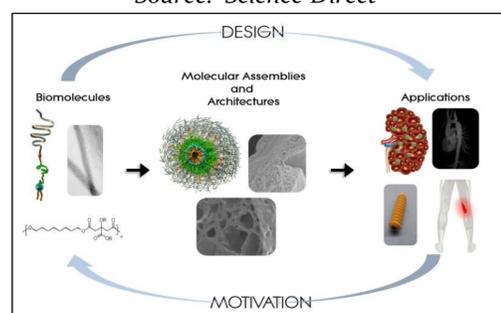
Atherosclerosis is the leading cause of many cardiovascular diseases, which cause 18 million deaths worldwide annually. It is the buildup of fats, cholesterol, and other substances in and on the walls of your arteries that can limit blood flow. There are also rare cases where the rupture of unstable plaques could lead to the development of thrombosis and myocardial infarction (heart attack). Therefore, the creation of a treatment that would allow for the detection of this vulnerable plaque would assist in preventing dire cardiac conditions.

Objective & Impact of Professor's Research

The objective of Professor's Chung's research is to develop nanoparticles, specifically self-assembling micelle systems. These nanoparticles can be harnessed to improve clinical procedures and current drug delivery methods to targeted areas within the body in order to minimize off-target effects and required dose of drug as a treatment method.



A diagram displaying the structure of an amphiphile micelle
Source: Science Direct

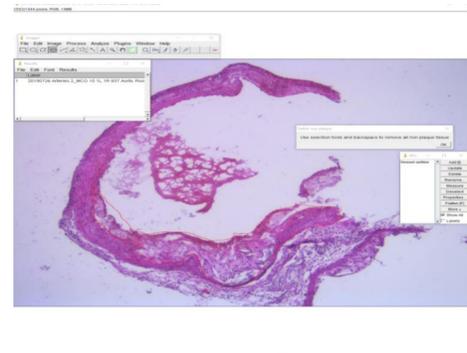


A diagram of Prof. Chung's vision for her lab
Source: <https://chunglaboratory.com>

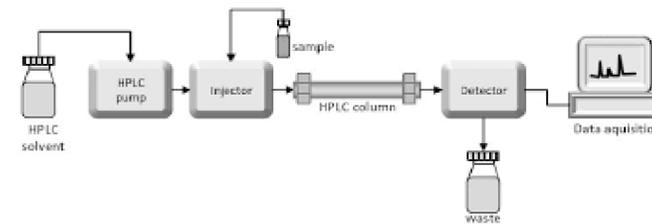
Skills and Techniques Learned

A number of skills that I have learned include:

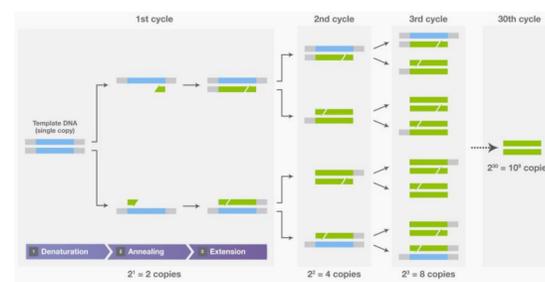
- Installation and setup of ImageJ
- Being able to identify different structures of arteries, aortic roots, and plaque morphology
- Using ImageJ software to analyze images
- Writing scripts on ImageJ
- Overview of HPLC (High Performance Liquid Chromatography)
- PCR (Polymerase Chain Reaction)
- Histology
- Microscopy
- SDS PAGE (sodium dodecyl sulfate polyacrylamide gel electrophoresis)



Analyzing an aortic root image through ImageJ. PC: Ethan Lee



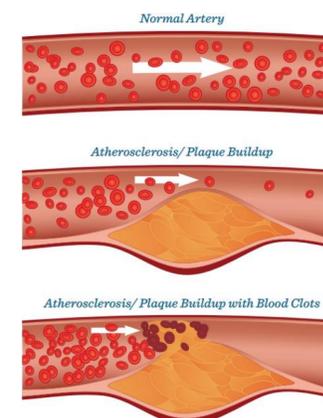
HPLC instrumentation and process
Source: Laboratory Info



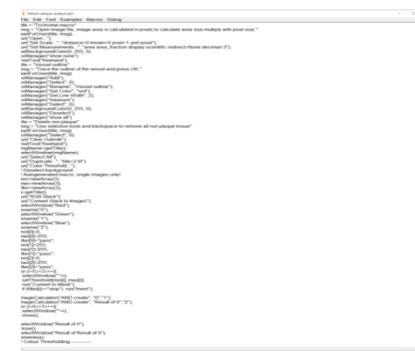
A diagram visualizing the PCR process
Source: Thermofisher Scientific

How This Relates to Your STEM Coursework

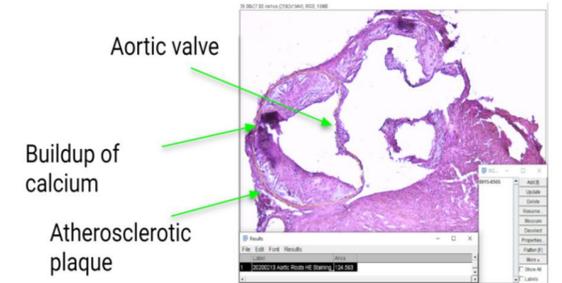
My SHINE experience has led me to understand how the biological concepts and biotechnological techniques taught within AP Biology can be applied to real world applications. I had the opportunity to learn more in depth about the structure of the arteries and unstable plaques. I was also able to realize that one field of STEM can be utilized in various areas as well. For instance, the script that I had to make run more smoothly involved coding, which itself is a different field of STEM than biomedical engineering. By making the script operate more smoothly, the process for analyzing aortic valve slides that is symptomatic with atherosclerotic plaque can run more smoothly as well. Furthermore, by using ImageJ to analyze aortic roots and atherosclerotic plaque, I was able to further my understanding of how biomedical engineering research would benefit society.



A diagram visualizing the buildup of plaque within the arteries
Source: <https://urmc.rochester.edu>



Inspecting the ImageJ script for measuring plaque and lipid area. PC: Ethan Lee



Labeling of an aortic root slide through ImageJ. PC: Ethan Lee

Next Steps for You and Advice for Future SHINE Students

Being a part of the SHINE program this summer has allowed me to realize that research is not a pathway that I will pursue. I plan on becoming a medical doctor in the future and hope to further explore this field throughout high school and college. I would advise future SHINE students to not be afraid of asking questions, asking for help when it is needed, and to be patient throughout the whole process. I also want to emphasize how it is okay to make mistakes while you are working on your SHINE research project and that mistakes are necessary if you want to improve and grow.

Acknowledgements

I am very thankful to Dr. Chung for allowing me to be a part of her lab, to my mentor Deborah Chin who guided me throughout this entire research process, to my partner Jason Lu, to the Center Mentors for their weekly check-ups and icebreakers with the sub cohort, and to Dr. Katie Mills and the SHINE staff for making this entire program possible. They made this experience much more fulfilling and educating.