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# AMSEC Internship

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# COLLEGE OF THE ENVIRONMENT

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**Internship Title:** Using Single-Cell ICP-MS in Studying Cellular Uptake of Nanopla

**Organization Worked For:** AMSEC/WWU

**Student Name:** Leo Curtis

**Internship Dates:** 1/9/24 6/15/24

**Faculty Advisor Name** Manuel Montaño

**Department** ESCI



**STUDENT SIGNATURE** 

**DATE:** 7/1/20

## Coursework and Experimental Application

These last two quarters working in the Montaño research lab have been invaluable in increasing both my general experience in a laboratory setting and in learning skills pertaining to the research of nanoparticles. This internship also provided me with an opportunity for professional development and feedback on my other scientific projects/pursuits. While I have taken the entire general chemistry and organic chemistry series, I am not often presented with the opportunity to deepen my understanding of this field of science. Getting to work on a project in this field increased my understanding of how chemistry, physics, material sciences, and biology are related and the advantages of an interdisciplinary approach to research.

One of my goals was to learn how to operate instrumentation that I had never used before in the context of environmental research. I learned the basics of how to operate the ICP-MS, and more specifically, began to learn to operate the ICP in a single-cell setting. This included the development of several skills and trainings, which included the basic AMSEC lab safety training. In addition, I had multiple sessions with professor Montaño practicing serial dilutions in preparation for the ICP. I also attended a compressed gas training, through which I learned the proper usage and handling of Argon gas tubes for use in the ICP-MS instrument.

Another one of my goals was to learn to develop a new method and validate it for use by future researchers. During the two quarters that I worked in the Montaño laboratory, the majority of my method development was in the form of research regarding methods for future use on the ICP-MS instrument. I compiled a list of papers regarding single-cell ICP-MS and began researching information regarding the success of these projects. Most of the information that I extracted from these papers was regarding the dwell times of the machine, how different cell sizes influence transport efficiency, how different transport efficiencies influenced the readings

of the machine, and comparing non-single-cell to single-cell ICP-MS. I also began looking for how other instruments, such as laser ablation, scanning electron microscopy (SEM), and transmission electron microscopy (TEM) could be included in our research to provide more comprehensive information about our experiments. I hope to have the opportunity to include other instrumentation in further research on this project.

Towards the end of Spring quarter, I gave a presentation to our lab group on one of the papers that I read. The paper that I presented concerned the cellular uptake of gold-doped nanoplastic particles by mouse macrophage cells. This paper provided me with a much more comprehensive background of real-life implications of single-cell ICP-MS. It also provided me with an opportunity to practice presenting scientific research to a group of people. Throughout the quarter, I had multiple opportunities to discuss presentations and scientific research with my lab group, which provided me with an opportunity for professional feedback on other projects.

## Future Experimentation

Future experiments should begin with research into nanoparticle-nanopolymer composite spheres, which behave as tracer particles (NP-tracers) (Project A). Tracer particles can be created when a polystyrene (a synthetic polymer) core is seeded with gold particles before being encased in a second polymer layer. This effectively creates a synthetic polymer particle that contains metallic tracers, which, when ionized, are able to be tracked and detected in the ICP-MS. It is important that we validate the use of NP-tracers in the ICP-MS before beginning single-cell experimentation to ensure that we are getting correct readings.

Once we have established the creation of tracer particles and have determined how to track them in the ICP-MS, we should develop single-cell methodology (Project B). Instead of introducing a single nanoplastic tracer into the plasma torch, an entire cell will be introduced. Prior to introduction to the instrument, cells will be seeded with NP-tracers created using the methodology discussed in the last paragraph. This allows us to quantify the amount of unique metallic signatures within each cell (NP-tracers/cell). This research requires cultivation of algae and protist cells to be used in experimentation, although there is potential for human epithelial cells to be used as well. If human epithelial cells are to be used during the final stage of experimentation, it is important to validate their use in single-cell ICP-MS before moving on to Project C.

Finally, we will preform an analysis of the impact of nanoplastic particles on cilial movement in both human epithelial cells and freshwater protists (Project C). NP-tracers created in Project A will be introduced to these cells to determine if their presence within the cell has a significant influence on cilia movement. Human cell/NP solutions will be analyzed with laser scanning confocal microscopy (LSCM) to determine the location of NP tracers and their impact on ciliate function. Protist/NP solutions will be analyzed with differential interference contrast (DIC) microscopy to determine the influence on the movement of multiple cilia within a protist. Project C will provide an understanding of the influence of nanoplastic particles on ciliate movement, which has significant real-life implications during the impending climate and plastic pollution crisis.