Playing with Peptides
Research in the Physical Sciences

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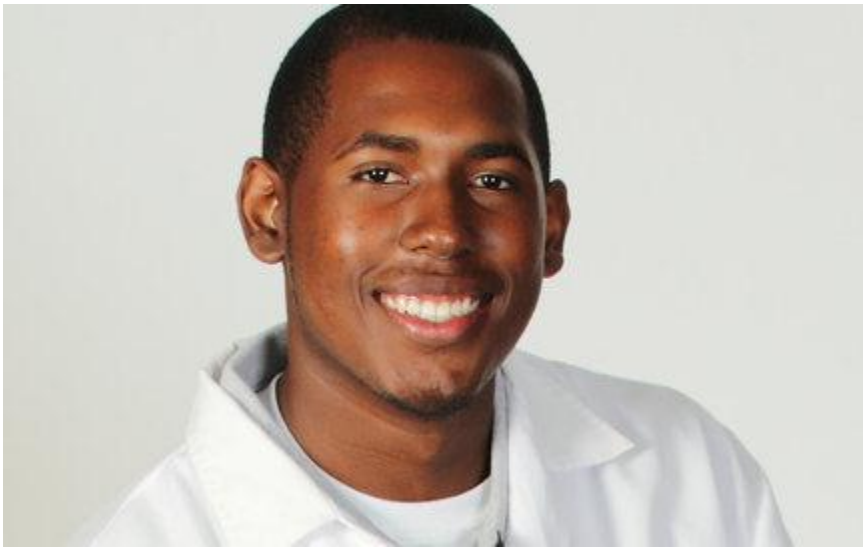

Photo Credit: Phil Channing, http://dornsife.usc.edu/news/stories/827/keeping-memories-alive/

Starting young

Maurice Turner is a junior at the University of Southern California (USC). He attended a small Christian private high school where he played football. Maurice was accepted in to several colleges, but picked USC for the overwhelming Trojan family spirit that was not palpable at other universities. Growing up in beautiful San Diego, California, Maurice was fortunate to have access to SCRIPPS Research Institute where he worked with Dr. Jeffery Kelly who researched the misfolding of proteins which leads to diseases such as Alzheimer's. During his time at SCRIPPS, Maurice learned and utilized advanced laboratory techniques such as solid phase peptide synthesis as well as HPLC (high performance liquid chromatography) to study and characterize proteins. The experience proved useful as he currently utilizes such practices in his research at USC.

Alzheimer's disease intrigued Maurice because his great aunt suffered from the disease, and she reached a point where she could not recognize Maurice before eventually passing away. This impacted him heavily at a young age and motivated him to invest his time into understanding, improving or even eliminating such disease conditions. He wanted to know why this disease struck her specifically. Why weren't all people equally affected by Alzheimer's? These questions

gave Maurice his first interest in the science behind diseases and the drive to discover and understand that field for himself.

Starting his career at USC

As a student in the Dornsife College of Letters, Arts, and Sciences, Maurice is studying Chemical Biology with a minor in Gerontology. The major Chemical Biology begs the question: "What is the difference between *Chemical Biology* and *Biochemistry*?" Chemical biologists utilize techniques in organic chemistry to study biological molecules on a chemical level while Biochemistry utilize biochemical techniques to study interactions of biological molecules and their greater role in biological systems. At USC, the two majors are closely related until they diverge into unique upper division classes during junior and senior years.

Maurice entered USC with Biochemistry declared as his major because Biology and Chemistry were two subjects he not only enjoyed but understood very well. The same year he entered USC as a freshman, the Chemistry Department introduced several new specialized Chemistry majors, Chemical Biology being one. Aware of his interests and previous research experience, Dr. Elizabeth Erickson, the Chemistry Freshman advisor, encouraged Maurice to take on Chemical Biology, which proved to be more than a perfect fit for his research desires.

Maurice became interested in Gerontology during Explore USC when his student host gave him a tour of the Gerontology department where he had the opportunity to meet several professors doing Alzheimer's work similar to Dr. Kelly. Realizing that Alzheimer's is one of several uniquely age-related conditions, Maurice decided a minor in Gerontology would not only be interesting, but would aid his research and future endeavors.

Experimenting with proteins

During his freshman year, Maurice was introduced to Dr. Chi Mak, head of the Chemistry Department through his Chemistry Research (CHEM 294) seminar. He presented a paper he had contributed work to at SCRIPPS to Dr. Mak and asked if he could find similar research at USC. Dr. Mak directed Maurice to Dr. Chao Zhang, who studies the chemical modulation of cancer and autoimmunity through structural biochemistry and protein engineering. While this was not necessarily Alzheimer's related work, the science utilized to study cancer used techniques very similar to Maurice's high school lab work—techniques he enjoyed and was proficient at.

With Dr. Zhang, Maurice essentially gets to play with protein science, creating new and original proteins through solid-phase protein synthesis. In this method proteins are made by single amino acid (the basic building blocks of proteins) additions to a growing chain. The initial amino acid is essentially glued to a gel wall in a test tube. A solution containing the next amino acid as well as various chemicals to aid the attachment bound amino acid is added. After allowing the solution to incubate for a time so the molecules can react, the amino acid solution is washed out leaving just the two amino acids bound to the gel wall. This process is repeated with different amino

acids until the desired protein is made. Finally the chain is released from the wall and purified using HPLC. The figure below diagrams the process of solid-phase protein synthesis.

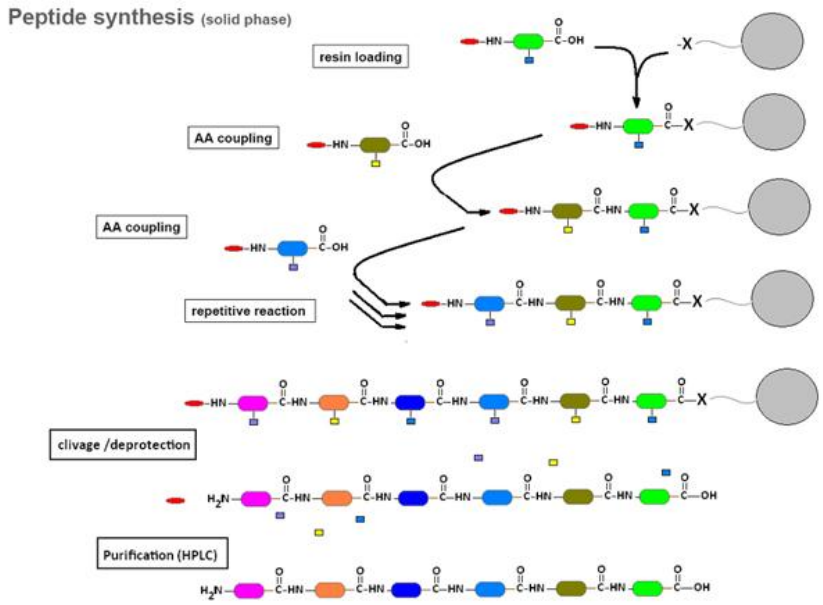

Figure 1: Solid-phase protein synthesis - http://www.synprosis.com/wp-content/uploads/2010/09/peptide.jpg

Maurice creates specific biological proteins for fellow researchers in the lab when requested for their unique experiments, and also has the opportunity to invent new proteins. His work does not have specific implications but a greater goal of expanding proteomics (the study of proteins; similar to genomics) by expanding the variety of proteins present in the world today. Most recently, Dr. Zhang has asked Maurice to help develop a protein that will function as a thiol kinase. A kinase is a protein enzyme that adds a phosphoryl group, or phosphorylates, another molecule. Thiol groups (–SH) exist throughout the body in various biological molecules. Protein function is based on its chemistry—the polarity and the electronegativity of the overall molecule as well as where negative and positive charges are located throughout the molecule (dipole).This chemistry leads to unique folds and shapes in proteins which translate to their different functions. Maurice's current goal is to develop a protein with the right sequence of polar and nonpolar, acidic and basic, charged and neutral, amino acids such that it will function as a thiol kinase. Once such a protein enzyme has been developed, the implication of thiol phosphorylation via this protein can be examined.

Conclusion

Many researchers, today, are interested only in science that answers specific questions to resolve problems, diseases, or conditions. Yet, science, at its core is a purely exploratory subject. It answers the questions “does or can this exist?” and “is that even possible?” Thus, Maurice’s research is the paradigm of science, the exploration of the unknown in search of answers to questions that do not yet exist. In the future, Maurice hopes to take his love of science and discovery into the field of medicine and attend medical school. He hopes to continue his scientific research as a medical student and then doctor, but does not know exactly where his future career will take him. His future, just like his research, will be yet another discovery to look forward to.