**Personal Statment**

“Scientist” is a career title that African Americans are rarely exposed to as they grow and are never likely to be pushed to achieve. Decades after the civil rights movement and integration, we as black people are still marginalized and lack opportunities to pursue certain disciplines, such as doctoral programs in STEM. I have personally committed to a lifetime of learning and reducing the minority gap for those pursuing higher education, not only in STEM but all disciplines. I have already begun taking the necessary steps to promote integration and diversity within our graduate programs by serving as a student leader. As one of two only African American males in the School of Pharmacy (SOP) graduate school, I am dedicated to increasing diversity and inclusion, especially during the recruitment process. I am currently serving as the graduate student representative in a newly created committee, the SOP Diversity and Inclusion Committee. With this opportunity, I am given a platform with the Dean, Directors, and Chairs to provide insight on how to make the current environment more equitable and just for minorities.

I also serve as one of twelve graduate student ambassadors for the University of Mississippi, which allows me to help recruit students from all backgrounds. Outside of the University of Mississippi, I am currently a scholar in three short-term fellowship programs that promote personal and professional growth. I am a Southern Regional Educational Board Scholar (SREB), Smith Scholar, and Neuroscience Scholars Program Associate (NSPA). Each program offers a very different skillset (research ethics, biostatistics, training for a career in academia, and population health research); thus, upon graduation, I will possess a wide array of skills that will foster my scientific and leadership skills in academia. The previously described programs and commitments are a major component of my graduate education now that a majority of my requisite coursework has been completed, and I will continue serving throughout my graduate tenure.

**Graduate Study Plan**

As a member of the Ashpole lab, our long-term goal is to determine how neuroendocrine modulators like insulin-like growth factor-1 (IGF-1) influence cerebrovasculature and overall health in the aged brain. *The central objective of this proposal is to assess whether IGF-1 benefits stroke outcome by acting directly on neurons and/or indirectly by modulating astroglia cells.* In the proposed project,  I will be using our novel inducible transgenic mice to specifically reduce IGF-Receptor (IGFR) in neurons or astrocytes and subsequently instigate ischemic stroke via middle cerebral artery occlusion. Following stroke, we will analyze tissue damage, behavioral changes, and cellular and molecular changes using a variety of biochemical and immunohistological approaches. We will first focus on our astrocyte-specific IGFR knockout mice (gfap-IGFR-/-; year 1: 2021) and will compare changes in infarct and behavior with our newest strain of neuronal IGFR knockout mice (camk2a-IGFR-/-; year 2: 2022). Completion of this project will allow for the determination of which cell type is responsible for the beneficial outcomes known to occur when exogenous IGF-1 is administered in the time surrounding ischemic stroke. These data will be crucial for the development of cell-targeted therapeutics and may become the foundation of developing very specific stroke treatments. My graduate study plan also consists of attending scientific meetings such as Society for Neuroscience and the Institute on Teaching and Mentoring. I will also attend a Gordon Conference and the Annual Biomedical Research Conference for Minority Students. I will also continue to mentor undergraduate research assistants, undergraduate Luckyday scholars, and minority STEM students through the Louis Stokes Mississippi Alliance for Minority Participation program. Although I only require one more course to complete my degree requirements, I plan to enroll in Teaching in Pharmacology courses to serve as a teaching assistant and another course on Responsible Conduct of Research.

As a minority male from a disadvantaged background, people in my circumstances often need noteworthy attachments for others to recognize and appreciate a fraction of our excellence. With the hopes of climbing the ranks of academia, I attest that the Ford Fellowship will directly benefit my future and indirectly benefit the hundreds of students I will mentor in the future on my journey to becoming a Principal Investigator, Chair, Dean, Provost, and President of a university. The Ford Foundation is an essential component of completing my vision: making higher education attainable for disadvantaged students and creating an equitable educational environment for graduate students.

Although enrolled in a doctoral program, I am far from displaced from the effects of racism, systematic oppression, and lack of opportunity. Low-income student, poorly funded K-12 education, single-parent household, Black, rural Mississippian, farm-raised, and first-generation college graduate are all the “boxes” I checked when I chose to change the narrative of my family. From my undergraduate grades, I would not be an ideal candidate for graduate school. As a senior in high school, I suffered a traumatic experience resulting in a severe case of Psychosis drastically causing my hands to become immobile and detrimentally attenuated my reading comprehension and study skills. Thus, as a 17-year-old with six months before the start of college, I had to relearn how to write and develop my reading comprehension skills. From this drastic experience, I learned to be persistent, resilient, and determined. Comparing my transcript of undergraduate courses to graduate courses, I look like two different students which shows that if given a chance, I can transcend the expectations and status quo of what would look like an unsuccessful student.

I strive to become a role model for children coming from my background and share my passion for science through my research and my teaching. As a first-generation student, I can directly relate to teaching individuals who do not have a strong K-12 education and are still developing their study skills and learning styles. Perfecting my craft came through tutoring my peers who are also first-generation college students mainly in Organic Chemistry. I continued to develop my teaching skills by tutoring “underprivileged/at-risk” African American young men at Oxford Intermediate School. My teaching skills were truly challenged when I had to teach STEM club for an entire semester for 1st-grade students. Translating scientific ideas into concepts that six-year-olds could relate to was probably one of the most challenging but rewarding teaching tasks that I have encountered.

My commitment to bettering the next generation reaches back to my hometown and local community and extends to others across the state of Mississippi. For the past few years, I have had the privilege of giving “How to Get to College” presentations to various high schools such as Byhalia and Morton High School which I am an alumnus of. I also mentor students who I have met while being an undergraduate ambassador and serving as a Summer College Counselor. And I have been fortunate enough to serve on multiple panels to encourage minority students to pursue higher education and coach them on how to overcome the challenges of pursuing a lifestyle that deviates from their surrounding community.

I am devoted to improving the matriculation of minorities into health-related professions. As an undergraduate junior, I brought one of my ideas to fruition, chartering a new chapter of the organization, Minority Association of Premedical Students (MAPS). MAPS’ goal is to provide professional and development opportunities for minorities pursuing careers in all health-related fields, not exclusively medical school. My commitment to service extends past the minority community as I served for two years as an undergraduate ambassador; am currently a graduate school ambassador; participated in multiple awareness walks for sclerosis, suicide, and breast cancer.

When I joined my Ph.D. program, I committed to a lifetime of learning and teaching. More specifically, I hope to be the face that other minorities do not see in academic institutions along with being the face for children like me who do not have the advantages of life that increase their likelihood of success in academic institutions. Having an extensive background in serving both the minority community and communities with multicultural backgrounds, I aspire to continue this work. Upon completion of my doctoral degree, I hope to secure a position as a post-doc and eventually become a Principal Investigator (PI) carrying my own independent research focused on molecular mechanisms and physiology of stroke. Despite the prevalence of cardiovascular diseases in African Americans, there is an obvious lack of black scientists in the biomedical science field which has truly emphasized my goal of obtaining a Ph.D. and pursuing a career in academia. Although I have a devoted love for research and plan on spending the early part of my career as a PI, I aspire to reach the highest ranks of academic administration to become a role model and fight to make higher education more accessible to minorities especially those who come from similarly disadvantaged backgrounds.

**Previous Research and Scholarly Productivity**

I became a member of the Ashpole lab as a sophomore undergraduate research assistant. My first project was focused on studying the role of neuronal insulin-like growth factor-1 receptor (IGF-1R) in learning and memory. *We hypothesized that neuronal IGF-1R in the hippocampus was essential in maintaining learning and memory in adulthood.* Using our transgenic models, mice underwent stereotaxic surgery for viral injection of Cre-mediated tools to reduce IGF-1R expression. Considering there are multiple types of learning and memory, we chose to assess working and spatial recognition memory since those are significantly affected in human populations with cognitive decline. Once I saw sex-specific behavioral deficits following IGF-1R knockout (KO), I attempted to delineate the responsible downstream mechanism. In addition to the expected changes in MAPK signaling, we observed alterations in Rho Kinase (ROCK) signaling as well. I uncovered a sex-specific reduction in the number of dendritic boutons following neuronal IGFR-KO. Given these changes, we attempted to rescue structure and function by simultaneously regulating neuronal IGFR and ROCK. Each phase of this project was intentionally planned as we tried to uncover the cellular and molecular mechanisms responsible for the altered behavioral phenotype. Through the completion of this project, I have learned to ask scientific questions and use several techniques, including stereotaxic surgery, immunohistochemical analysis, and protein detection, to answer these questions and finally convey these findings in a manuscript. From this project, we learned that neuronal IGF-1R is essential in maintaining learning and memory in adult male, but not female mice. This study (Hayes et al) is currently under review at the *Journal of Neuroscience*.

As a junior undergraduate student, I was selected as one of four students to participate in a six-week International Research Experience in Poland funded by the National Science Foundation. There, I conducted field research collecting fungi for natural product extraction, collected and analyzed ectomycorrhizal fungi, organized an international conference, and learned a variety of extraction techniques. Also, I served as an undergraduate researcher in the Hoeksema lab, compiling and collecting data on hundreds of previously published articles on mycorrhizal fungi for a large meta-analysis study. Being able to compile data for a meta-analysis before the start of graduate school provided me the foundation to understand and translate scientific literature along with providing experience in a field I would not have been exposed to.

My current graduate project in the Ashpole lab aims to understand which cell type utilizes IGF-1 to protect against the neurological damages caused by an ischemic stroke. While completing a comprehensive literature review on the role of IGF-1 in preclinical and clinical studies (in revisions at *Journal of Cerebral Blood Flow and Metabolism)*, we saw a gap in understanding whether neurons or astrocytes were responsible for the beneficial effects of IGF-1 on stroke outcomes. *Thus, we hypothesized that* ***the regulation of both neurons and astrocytes by IGF-1 contribute to the extent of damage following ischemic stroke****.* To test this hypothesis, I developed a plan to induce cell-specific reductions in IGFR in adult mice and subsequently assess the effects of middle cerebral artery occlusion. Following genetic manipulation and stroke, sensorimotor behavioral tests (cylinder/rotarod) and avoidance memory will be assessed. *Ex vivo* analysis will be conducted using western blotting, immunohistochemistry, and confocal microscopy. I will also use *in vitro* experiments to determine how pharmacological and genetic reductions of IGF-1R signaling alters astrocytic neuroprotection from oxidative stress and excitotoxicity. Overall, we expect to see fewer deficits when neuronal IGFR is reduced as astrocytes will continue to provide supporting functions like reducing glutamate excitotoxicity and ion homeostasis. This project will help further the development of cell-specific post-stroke therapeutics to target oxidative stress and inflammation, two major components of stroke damage. Upon completion of this project, I will have an extensive background in cellular/molecular analyses, *in vitro/in vivo* experimental design, microscopy, and statistical analysis using various programs such as R, Matlab, and Sigmaplot. I am also a team member on a project studying the role of early life exposure that THC has on aging which requires surgical experience, conducting animal behavioral tests, and ex vivo analysis. These data are currently being used for a manuscript proposal and preliminary data to apply for an NIH-funded R01.

My passion for understanding inflammation and stroke extends from basic science to population health studies. As a Smith Scholar, I can access data from the Jackson Heart Study (JHS), one of the largest minority health disparity studies in the United States, to gain valuable insight into how cardiovascular disorders affect African Americans. More specifically, I am currently exploring the association between inflammation levels (high sensitivity-C Reactive Protein) and stroke incidence in African Americans. Upon completion of this two-year program, I will have a clear understanding of biostatistics and study design using observational data.

**Publications:**

1. **Insulin-like Growth Factor-1 and Ischemic Stroke Outcomes: Evidence from Clinical and Preclinical Interventions: Hayes C**, Valcarcel-Ares MN, Ashpole NM (in revisions) Insulin-like Growth Factor-1 and Ischemic Stroke Outcomes: Evidence from Clinical and Preclinical Interventions. Currently *Submitted to Journal of Cerebral Blood Flow and Metabolism*
2. **Neuronal Insulin-like Growth Factor-1 Receptor in Learning and Memory.Hayes C,** Hodges E, Marshall J, Dalman D, Logan S, Farley J, Owens D, Sonntag W, Ashpole NM (under review) Adulthood Deficiency of the Insulin-like Growth Factor-1 Receptor in Hippocampal Neurons Impairs Cell Structure and Spatial Learning and Memory in Male Mice. *Submitted to Journal of Neuroscience*

**Presentations:**

**2019** **Society for Neuroscience 2019**

* "Reductions in hippocampal IGF-I signaling in adulthood negatively regulates neuron structure and cognition” **Cellas Hayes**, Erik L. Hodges, Jessica Marshall, and Dr. Nicole Ashpole

**2019** Trainee Professional Development Award **Presentation at Society for Neuroscience 2019**

* "Reductions in hippocampal IGF-I signaling in adulthood negatively regulates neuron structure and cognition” **Cellas Hayes**, Erik L. Hodges, Jessica Marshall, and Dr. Nicole Ashpole

**2018** **Annual Biomedical Research Conference for Minority Students (ABRCMS) 2018**

* “Reduction of IGF-I Receptor in the Adult Hippocampus Impairs Learning and Memory” **Cellas Hayes** and Dr. Nicole Ashpole

**Oral**  **2018**

**2018 Presentation at the University of Mississippi for 50 Congressional Delegates from Washington D.C**

* Aspects of IGF-I and the aging brain.

**2018** **Oral Presentation at Mississippi Academy of Science 2018**

* “Reduction of IGF-I Receptor in the Adult Hippocampus Impairs Learning and Memory” **Cellas Hayes** and Dr. Nicole Ashpole

**2018** **Presentation at Mississippi Academy of Science 2018**

* “Reduction of IGF-I Receptor in the Adult Hippocampus Impairs Learning and Memory” **Cellas Hayes** and Dr. Nicole Ashpole