MEREDITH COLLEGE

URP Research Grant 2018-2019

Student Name:
Amount Requested:

Office Use Only:
Date Received by URP:
Date Reviewed:
Funding Decision:

1. **Please fill in the following student information:**

Student Full Name	Student Email	Student Phone #	Student ID #
Morgan Rose	mlrose@email.meredith.edu	9195008853	0381051

2. **Faculty Research Mentor Information**

Faculty Name	Faculty Email	Faculty Phone #	Department
Dr. Aghoram	aghoramk@meredith.edu	(919) 760-8187	Biology

3. **Departmental Budget Officer Information**

Budget Officer Name	Budget Officer Email	Budget Officer Phone #
Amanda Powell	aspowell@meredith.edu	(919) 760-8641

4. **How many semesters have you been working on this project?**

___ 0 – 2 semesters
_X_ 3 – 4 semesters
___ More than 4 semesters

5. **How many semesters have you been working with this faculty sponsor?**

___ 0 – 2 semesters
_X_ 3 – 4 semesters
___ More than 4 semesters

6. **Have you received funding in the past from the Office of Undergraduate Research?**

_X_ Yes. ***If yes, please answer the following two questions.***
___ No

7. **What type of funding did you receive? Please select all that apply.**

MEREDITH COLLEGE

URP Research Grant 2018-2019

___ Travel Grant
___ Research Materials Grant
_X_ Summer Research Grant

8. **Please answer the following questions if you have received funding from a Meredith Undergraduate Research grant previously:**

Date Awarded	Amount Awarded	Purpose of Funding
02/03/2018	$319.06	(Mentor's note): Although this amount was awarded, we did not use it because I was unable to get the gene sequences optimized and submitted before the end of the semester. Now, I have the sequences ready to go. Hence, Morgan is resubmitting the proposal. We appreciate the committee's consideration.

9. **What is the total amount of funds requested on the current proposal you are submitting?**

$467.06

10. **If applicable, explain any other sources of funding for this project. This includes: Departmental or school funding, other outside grants and awards:**

11. **If your request is more than then $500 Research Grant limit, how do you expect to procure the amount above $500? (e.g. School funds, department funds)..**

***The following 5 items are evaluated by the Undergraduate Research Advisory Committee for incluness. Every section must be completed in order for the proposal to be considered.**

12. **Introduction (Background and Context):** Succinctly indicate what your project is about. Articulate the context of your research explaining the scope and parameters of your subject matter. Demonstrate how your research fits within the larger academic context of your subject, explaining where your work might help to address issues that are not currently understood. Use the appropriate citations in this section.

Drought or water-deficit stress is one of the major causes for global crop losses and understanding the molecular genetics of plant responses to drought is a critical endeavor in improving agricultural productivity (Bray 1997). The overall goal of our research is to identify genes responsible for drought tolerance and engineer them into plants to create drought-tolerant crops. Scientist Antonie Van Leeuwenhoek discovered in 1702, some small organisms could go into a state of reduced metabolic activity and survive harsh conditions such as desiccation, radiation,

and extreme heat. One example is tardigrades; while they can be found in extreme environments, they are commonly found in environments with water and moss. Commonly referred to as "water bears," tardigrades can enter into an extreme state of survival, where, all metabolic activities slow to an unmeasurable rate.This state allows the organism to survive a number of years past its normal lifespan. This stress response has to be coded in the organism's DNA and RNA. Various studies have shown that a family of proteins called the heat shock proteins (or Hsp) could be involved in creating and maintaining the cryptobiotic state (Schill). Our research group wants to take the gene sequence for a heat shock protein from a tardigrade and determine if it can be introduced into the genome of a plant to make it resistant to drought. We hope to put the tardigrade gene into Glycine max, also known as a soybean plant. Engineering genes into a soybean plant will also allow students to learn and practice molecular techniques such as DNA extraction, polymerase chain reactions (PCR) and western blots when the plant reaches maturity.

13. **Research Concept:** Articulate the specific **research question, hypothesis, idea, scholarly question**, or **problem** you are investigating.

The project is focused on developing an efficient system of agrobacterium mediated transformation that future research students can utilize to learn about plant transformation and various laboratory techniques and procedures. It will be focused initially on a tardigrade gene that is believed to be a heat shock protein involved in anhydrobiosis. The transcript of this gene was provided by collaborators at The University of North Carolina at Chapel Hill. This gene will need to be synthesized and cloned into a plasmid, then the engineered plasmid can be introduced into the genome of a plant. Once this system has been implemented, future students researching at the 299 level can conduct a literature review of a gene and be given the chance to transform a plant using the gene they researched when they reach the 499 level of research..

14. **Methodology:** Clearly summarize your research, creative process, scholarly work. Include practices, techniques, or survey instruments used, size, and length of study, and analytical tools used to assess the data, the product, or conclusion. Use appropriate citations.

A research team at UNC Chapel Hill has done research on tardigrades recently and have found the gene sequence that is responsible for the tardigrades drought resistance. After coming into contact with them, Dr. Thomas Boothby, part of the Chapel Hill team, gave the gene sequence for plasmid extractions (Boothby, 2015). This gene sequence will be sent over to a laboratory (Genscript) for gene synthesis. The synthesized gene will be placed (also by Genscript) in the plant expression vector pCAMBIA 1301. Once we have this gene construct, we will use an Agrobacterium transformation method to engineer transformed Glycine max plants. Agrobacterium is used to cause tumors in plants through gene transferring. Agrobacterium is well known for its ability to transfer DNA between itself and plants. Our methods will be based upon the protocol for "Soybean Whole-Plant Transformation Half-Seed Explant (Stupar Lab)." This protocol outlines the necessary steps for transforming mature soybean seeds. The seeds will be germinated and cut into explants then inoculated with the agrobacterium containing our gene of interest. The explants will then be moved onto different medias to initiate shoot growth and shoot elongation. Once the explants have reached a desirable size, they will be moved to a rooting media where the plant callus will be removed and roots will be initiated. Once substantial roots have formed, the plants will be moved to soil. Students will then be able to sample the plants and

extract DNA to perform tests such as PCR to ensure that the plant is transformed and a western blot to determine if the plant is expressing the protein the gene coded for.

15. **Institutional Research Board (IRB) Review: if your project involves human research subjects, have you obtained Meredith College IRB Approval and supplied Dr. Paul Winterhoff, the Director of Undergraduate Research, with documentation of this approval?**

Only select "Yes" if your research project is one that needs IRB Review/Approval. If this does not pertain to your research please move forward to the next question.

___ Yes

16. **Educational Benefits:** In a short paragraph, explain where you are now in terms of your preparation for conducting this research, interpreting results, discoveries, or performance and completing the project. Then, articulate the learning outcomes you expect from this project (i.e. how this project will benefit you, how the research might be continued, and what knowledge and skills you plan to gain from doing it).

By engaging in independent research students are exposed to a number of skills that are easily transferred from academia to the career of their choice. Specifically with this research, students get a first-hand look at how developing transgenic crops can help alleviate major problems that limit agricultural productivity. They will learn that tardigrade DNA is no different that plant DNA in structure and function. They also gain mastery of specific, cutting-edge lab techniques such as gene cloning and genetic engineering. Students will learn how to do molecular techniques such as DNA extraction, PCR, western blots, as well as skills involved in handling and transferring tissue cultures. Even outside the lab the students are learning how to write scientific papers and experiencing first hand all the work that goes into finding legitimate sources for a topic. Along with the more concrete skills the students are learning how to be a part of a team, which involves being accountable and civil. After the project the students will have learned to be confident through the public speaking aspect that presenting their research brings. Not only will this experiment allow for advances in science but it will also promote the personal growth of the students involved.

17. **References:** A list of references from peer-reviewed journals and in-text citations should be included in your introduction and methodology (as needed). Citation Style and references should be formatted according to your area of study.

Bray EA: Plant responses to water deficit. Trends Plant Sci. 1997;2(2):48–54. 10.1016/S1360-1385(97)82562-9 Boothby, T. C., Tenlen, J. R., Smith, F. W., Wang, J. R., Patanella, K. A., Nishimura, Thermo Fisher Scientific. ElectroMAXô Agrobacterium tumefaciens LBA4404 Cells. ElectroMAXô Agrobacterium tumefaciens LBA4404 Cells, Inventrogen, 2003. Rebecchi, Altiero, Guidetti. "Anhydrobiosis: the extreme limit of desiccation tolerance." 28 June 2007, http://www.isj.unimo.it/articoli/isj137.pdf. Accessed 7 November 2017. Schill, Steinbruck, Kohler. "Stress gene (hsp70) sequences and quantitative expression in Milnesium tardigradum (Tardigrada) during active and cryptobiotic stages." April 2004, https://www.ncbi.nlm.nih.gov/pubmed/15073193. Accessed 16 November 2017. Stupar Lab.

"Soybean Whole-Plant Transformation Half-Seed Explant." University of Minnesota, The University of Minnesota, 2018, stuparlab.cfans.umn.edu/protocols/soybean-whole-plant-transformation-half-seed-explant.Sensitive Mimosa Pudica Electrophysiology. Experiment: How Fast Your Brain Reacts To Stimuli. Backyard Brains.

18. **Itemized Cost:** Provide a complete and detailed list of supplies with project costs.

Gene synthesis from GenScript: $319.06 https://www.genscript.com/ Vector: $148 (http://www.axxora.com/MGT-M1592/pcambia1301-plant-expression-vector) Total Amount Requested: $467.06

19. **My faculty mentor has reviewed and approved this proposal and all its specific items, fees, and costs with my submission, and will send approval directly to research@meredith.edu.**

_X_ Yes

___ No