Intellectual Merit Criterion

Overall Assessment of Intellectual Merit
Excellent

Explanation to Applicant
The applicant is proposing to evaluate the co-evolutional interaction of newt-garter snake toxin and venom. The review related to the hypothesis is well elaborated and the function of both venom and toxin are known. The former study and research of the applicant are a strength for the proposed study. The endorsement of scientists from the field is a proof of mentorship or potential that help with the feasibility of the study. The study on tick salivary gland expression analysis is like the proposed study, which is strengthening the idea's feasibility. The hypothesis, aims, and methodology on toxin and venom are well elaborate and define. The main objectives are feasible.

Broader Impacts Criterion

Overall Assessment of Broader Impacts
Excellent

Explanation to Applicant
The project will advance our understanding of the coevolution of venom and toxin proteins. Coevolution can call for activation/inhibition of gene expression or protein synthesis that marks the phenotype result of evolution. This study has training potential in various field and mentorship in the STEM field in general. The applicant is planning to create classroom modules for online learning. The study has the potential to provide insight into the mechanistic of molecular resistance. The science and society would surely benefit from results of the study backed with scientists' letters from the field.

Summary Comments
The applicant is proposing to evaluate the co-evolutional interaction of newt-garter snake toxin and venom. The review related to the hypothesis is well elaborated and the function of both venom and toxin are known. The former study and research of the applicant are a strength for the proposed study. The endorsement of scientists from the field is a prove of mentorship or potential that help with the feasibility of the study. The study on tick salivary gland expression analysis is like the proposed study that is strengthening the idea's feasibility. The hypothesis, aims, and methodology on toxin and venom are well elaborate and define. The main objectives are feasible. The project will advance our understanding of the coevolution of venom and toxin proteins. Coevolution can call for activation/inhibition of gene expression or protein synthesis that marks the phenotype result of evolution. This study has training potential in various fields and mentorship potential in the STEM field in general. The applicant is planning to create classroom modules for online learning. The study has the potential to provide insight into the mechanisms of molecular resistance. The science and society would surely benefit from results of the study backed by scientists' letters from the field.

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit
Very Good

Explanation to Applicant
In this proposal the applicant plans to test the hypothesis that different newt populations will vary in resistance to garter snake envenomation due one of four molecular mechanisms (venom inhibitors, altered targets, repurposed toxins, or acquired immunity). The applicant has studied differential venom gene expression in the Common Garter Snakes (Thamnophis sirtalis) at

her undergraduate institution for three years, and had a summer REU bioinformatics experience that strengthened her skillset to be able to address this proposed research. My concerns are mainly about the tractability: is it possible/cost effective to collect that many animals from that many sites? Are permits needed? Also, is there a possibility that multiple molecular mechanisms might be at play? I am not sure this was well spelled out.

Broader Impacts Criterion

Overall Assessment of Broader Impacts
Good

Explanation to Applicant
The proposal discusses nice past experiences of outreach and peer mentoring. There is evidence presented of the benefits of the outreach provided. The proposed broader impacts are not as well defined and have no methods of assessing the impacts. Some evidence of a possible collaboration with the publisher should the work be funded would be good to show that any modules produced based on the research would indeed reach a large audience.

Summary Comments
Overall, I think that the applicant has prepared a proposal that has the potential to advance knowledge in host-consumer arms races (Specifically the well-cited newt/garter snake system). Although the plan presented is well organized, there was no mechanism to assess success-I am not sure what level of information gleaned from the bioinformatics study will be useful enough to "fill the gap" in the snake venom role in the arms race. The applicant has had ample research opportunities at her home university and as an REU student. These have led to several regional presentations and co-authorship on a manuscript. Although I do not know where the applicant plans to carry out the work (so I cannot assess the qualification of the support they will receive nor the availability of adequate resources needed to support the research), I do think the applicant has the skills needed to do the work based on past experiences, and the comments made by the letters of support. In terms of the broader impacts, the applicant has had prior experience in public outreach and mentoring peers in the lab. There is evidence that the outreach has had beneficial effects (letters from participants). The planned broader impacts are lee well defined. I am not sure it is as easy as stated to prepare modules for publishers to use with their texts. Continued outreach though social media is a good idea.

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit
Good

Explanation to Applicant
Strengths -The student has a high GPA from South Alabama. -Aim 1 of the research proposal presents a detailed molecular characterization that is necessary. Weaknesses -The student does not seem to have taken calculus. This is likely to be important knowledge for modern biology. -The bioinformatics analysis seems to consist mostly of using existing software from others. -Aim 2 is fishing for mutations to study the co-evolution with toxins in venom. It may be necessary, but isn't creative.

Broader Impacts Criterion

Overall Assessment of Broader Impacts
Very Good

Explanation to Applicant
Strengths -The student has a focus on outreach. -The YouTube channel to create resources for K-12 education seems like a valuable initiative. Weaknesses -No major weaknesses were found here.

Summary Comments

This is a research proposal on co-evolution between garter snakes (venom) and newts. This is a system that has been studied by others. Some of the chemical analysis is well received, but the mutational analysis could have included more. The lack of math background may be a hinderance in a career in evolutionary genomics. The broader impacts outreach initiative was well received.

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit

Excellent

Explanation to Applicant

The applicant is a talented ECR that proposes to research the evolution of venom resistance in toxic newts, thereby extending the framework for the co-evolution of a textbook predator-prey arms-race system. The applicant has been successful as an undergraduate and has done well with the research opportunities they have had. This is an exciting proposal that builds on the applicant's undergraduate research into the venom of garter snakes, and shows a clear progression of thought that builds on the foundational knowledge and the newly acquired knowledge to ask insightful questions. The two aims are well worked out and the proposed methods and analyses are appropriate. The applicant has acquired the skills necessary to perform the research and seem poised to tackle the research they have outlined. No mention of the intended grad program is made, but there are certainly a few labs working on this system that would provide the required infrastructure. A weakness is that the student has not had opportunity to publish their undergraduate work, although given their stage this is not unexpected, and they are in included as a coauthor on a minor herpetology natural history note.

Broader Impacts Criterion

Overall Assessment of Broader Impacts

Very Good

Explanation to Applicant

The outreach activities are focused on mentoring under-represented STEM students in research that will entail field, to bench, to informatics approaches. The mentees will also be engaged in developing some educational modules focused on the research that expand a textbook example system. The modules will be disseminated through a YouTube channel that the grad student has developed for k-12 science education. A weakness of the planned activities is that metrics of success are not mentioned. Since the YouTube channel exists and has been used for previous outreach inclusion of some information about the success of the dissemination method (e.g. number of views, locations of views) would help gauge the impact of the activities. A plan to do this summation going forward would strengthen the proposal.

Summary Comments

The applicant has demonstrated that they are capable of carrying out and planning a cohesive research project that builds on itself as discoveries are made. The proposed research and BI activities present a cohesive agenda for their graduate work. Additional details on outreach assessment and of course publication of the undergraduate venom research would strengthen the project.