

## Intellectual Merit Criterion

### Overall Assessment of Intellectual Merit

Excellent

#### Explanation to Applicant

The applicant has a stellar academic record, and has conducted research that have not only provided significant, formative experiences, but for which he has also had a formative impact on those projects and individuals with which he has worked. It is clear that the applicant exhibits a maturity beyond his years, and is more than ready to excel in a research project of his own design. With gracious support from his advisor, it is more than evident that this is an ideal intellectual/research environment that will be of mutual benefit.

The proposed study is designed to consider the possible responses that the acorn barnacle (an integral member of Pacific intertidal food webs) may have to oceanic acidification. Although limited in physical space to present three important questions that he would like to ask, the applicant has very nicely described each of these and the mechanisms by which he intends to address them. Not only are each of these questions biologically relevant, but the way in which they are presented in the proposal demonstrates a true understanding of the research questions and the appropriateness of the application of the methods proposed. They are logical, they are clear, and they are concise. Most of all, they are doable, are well-supported/endorsed, and could lead to some very interesting findings that would be applicable to various academic and non-academic situations/scenarios.

## Broader Impacts Criterion

### Overall Assessment of Broader Impacts

Excellent

#### Explanation to Applicant

Ecologically, the results of the study would be of great benefit to those individuals considering the ability of marine organisms and communities to adapt to/tolerate changes in ocean acidity associated with global climate change. Additionally, the applicant has had vast experience working with a number of local, regional, and national organizations, and I anticipate a continued commitment by the applicant to work with these groups in various capacities (academic, policy-making and decision, education).

I was particularly appreciative of the applicants commitment to STEM education, and hope that the applicant pushes himself further to develop new activities in novel ways to not only develop online education exercises, but to also involve high school and undergraduate science students into his own research project. Such involvement at a high school and undergraduate level was so very instrumental to him; now, it would be great for him to develop a similar, if not more rewarding, opportunity for others.

## Summary Comments

I was extremely impressed by the applicant and his proposed study that considers the adjustments of a 'cornerstone' species of barnacle to the impending increase in ocean pH associated with global climate change. The proposal reflects an acute understanding of three potential responses by these barnacles (migration, acclimation, and adaptation), and how one might be able to assess these through studies that consider phenotypic plasticity and heritability in traits associated with these responses. The applicant has an exceptional academic record, a long history of impressive experiences as a high school student and as an undergradute, and now a furtive, extremely supportive group that will work with the applicant in this endeavor- a real win-win for all involved. The applicant is extremely knowledgeable, technically savvy, and has a good understanding of the Scientific Method to consider a significant question in science that would be extremely beneficial at multiple levels.

## Intellectual Merit Criterion

### Overall Assessment of Intellectual Merit

Excellent

### Explanation to Applicant

The applicant has an outstanding academic record in a scientifically rigorous curriculum. Applicant has previous research experience but this has only resulted in one presentation at a REU conference; one ms is in the latter stages of preparation for submission to Ecology. The applicant provides an in-depth research plan on a study of the environmental effects of ocean acidification, which, if completed, will provide groundbreaking work on an underappreciated effect of global warming. All letters of recommendation are highly supportive and suggest that the applicant is proceeding at an academic pace that far exceeds his peers.

## Broader Impacts Criterion

### Overall Assessment of Broader Impacts

Very Good

### Explanation to Applicant

The applicant has not been involved in community outreach but has participated in numerous student organizations. Applicants states that a GRF would allow him to mentor and teach both undergrads and high school students to increase the representation of minority groups but does not provide the means by which this will happen.

## Summary Comments

Applicant shows great promise as a researcher in an area that is just starting to be studied but will have tremendous importance in marine systems. The applicant could improve the research statement by explaining the potential impact on a broader audience and how an NSF GRP will help him reach underrepresented groups with the results of his research.

## Intellectual Merit Criterion

### Overall Assessment of Intellectual Merit

Very Good

### Explanation to Applicant

The applicant has a strong academic background and is a self-taught techie. He has had multiple research experiences and one REU presentation. He proposes to examine whether acorn barnacles from a high and a low pH site differ physiologically and genetically, as a proxy for examining the effects of human-caused ocean acidification. The research plan is clearly articulated, but the results will be difficult to interpret because the applicant only plans to study barnacles from two sites. Since he does not plan to replicate the pH factor, the results of the experiment will not be useful for assessing the effects of high and low pH on barnacles.

## Broader Impacts Criterion

### Overall Assessment of Broader Impacts

Very Good

### Explanation to Applicant

The applicant has been involved in several citizen science projects, including Googles high altitude weather balloon activities. He mentions working with K-12 student groups on this project. He addressed the broader impacts of his proposed research and mentioned working with interdisciplinary groups, publication in open-access journals, and work with undergraduate researchers.

## Summary Comments

The applicant has a strong academic background, technical skills, and research experience. The application shows promise for productive research and science communication.