

Grand Challenges In Organismal Biology

NSF has presented SICB with a significant opportunity to initiate the framing of the ‘Grand Challenge’ questions to drive funding in Organismal Biology. The timeline however is short. Several of us have been discussing how to facilitate input from all members of SICB. We suggest the creation of a discussion chat room within the member space on the web where possible articulations of ‘Grand Challenge’ questions can be posted, discussed and honed.

To begin the discussion two such drivers of our science are articulated below.

1. What are the linkages among genotype, phenotype and the function/performance of organisms and what are their mechanisms of operation?

Currently the focus is on descriptive, pattern based, gene/genome sequencing, and single gene responses but not on the mechanistic drivers or the feedback loops at a systems level. These include dynamic feedbacks through evolutionary and environmental responses as well as the plasticity of responses at all levels of organization.

2. Similarly, the physical environment, physiological and developmental processing, and organismal function and responses are clearly linked, but how do those linkages work and how do the responses translate into changes in population, community and ecosystem functions? What are the feedbacks among these levels of organization and what are the modulators and control functions?

Advances have been made in physical biology such that we are better able to predict/model the physical environment and material/mechanical/physical limitations and constraints (or opportunities) for organisms, but we lack mechanistic understanding about how this information is used/sensed/translated at the organismal level, nor do we understand the integration at the organismal level that then translates into function and performance.

We must address such questions if we are to understand and predict any of the following:

- organismal and system responses to climate change
- restoration and resilience of natural resources
- organismal responses to the challenges of increases in emergence of new diseases etc.
- changes in gene expression and phenotypic integration of those changes

NSF Time horizons for SICB input to be effective:

2-4 Weeks – articulate 1-3 basic big, overarching questions. These “leading edges” will be discussed among NSF program officers in Biology. This is when the formulation of ideas for new special programs will take place. Organismal Biology needs to be a unified voice, articulating the needs of this community. All other areas of science will be doing the same – we need our questions to be prominent, and articulate them as the core of all biological questions with organisms as the integrators.

2-3 Months – detailed articulation/ refinement of Grand Challenges. Recommend how NSF could facilitate finding answers to these grand challenges i.e. what is necessary for their resolution. Funds for tool development? Synthesis Center (we have the data, we just need to synthesize it)? Directed calls for interdisciplinary work? What do we need from NSF to solve these Grand Challenges.

2 yrs – further development and discussion and buy in from all of the organismal biology community about what the big questions are and how NSF can help us answer them.