

Title of proposed program: Mechanobiology: An Emerging Frontier in Basic and Translational Research

Submitting Source: Strategic Planning Meeting

What is the major obstacle/challenge/opportunity that the Common Fund should address?

Mechanobiology is an emerging frontier in research, at the interface of biology and engineering, that involves the study of physical forces and changes in cell or tissue mechanics. Cells are exquisitely sensitive to mechanical stimuli, and their ability to detect mechanical cues is critical to stem cell biology, developmental biology, and a wide variety of diseases. A major challenge in the field is understanding mechanotransduction -- the molecular mechanisms by which cells and tissues self-organize, and sense and respond to mechanical signals. At present, research in mechanobiology is rather piecemeal with different communities working on select diseases, cell types, and model organisms. Unifying approaches and datasets that could add much needed coherence to the field are simply not available. With support from the NIH Common Fund, new research foundations and insights into the mechanical basis of tissue regulation could lead to development of improved medical devices, biomaterials, and engineered tissues for tissue repair and reconstruction.

What would the goals of the program be?

This program would have 4 goals:

- Develop new techniques to measure mechanical forces in living organisms from nanometers to meters and milliseconds to years.
- Integrate understanding of mechanical signal transduction across log scales ranging from the cellular to the tissue to the organism level.
- Apply knowledge to the creation of complex bioengineered biomaterials (tissues and whole organs).
- Make engineered biomaterials available to the research community to advance development of new medical devices and tissues for reconstruction.

Why is a trans-NIH strategy needed to achieve these goals?

The Common Fund is uniquely positioned to drive progress across the NIH to coordinate the emerging field of mechanobiology into a coherent whole.

What initiatives might form the strategic plan for this topic?

- Develop new techniques to measure mechanical forces in living organisms from nanometers to meters and milliseconds to years.
 - Facilitate the development of new techniques for studying mechanotransduction in natural and bioengineered materials.
- Establish datasets and analytical capabilities to integrate the understanding of mechanical signal transduction across log scales ranging from the cellular to the tissue to the organism level.
 - Emphasize cellular unity.
- Apply knowledge gained to the creation of complex bioengineered biomaterials (tissues and whole organs) and datasets for use by the broader research community.
 - Create nature-inspired biomaterials using molecular self-assembly.

If a Common Fund program on this topic achieved its objectives, what would be the impact?

A successful project create coherent field of in mechanobiology. Since mechanobiology requires interdisciplinary knowledge, the project will develop a unified effort developed out of the marriage of powerful concepts from traditional fields of cell biology, mechanics, and materials.