



## NASA STTR 2018 Phase I Solicitation

### T3.03 Bio-inspired Concepts for the Development of Power, Energy and Storage Technologies for Air and Space

Lead Center: GRC

Participating Center(s): ARC, LaRC

Technology Area: TA3 Space Power and Energy Storage

Biomimicry is the imitation of life and life's principles characterized by reduced use of energy, water and raw materials. Energy and material use is substituted by information and structure. The goal of this topic is to focus efforts on system driven technology development that draws from nature to solve technical challenges in aeronautics and space exploration. This subtopic is also looking for proposals that include data collection that would add to the Periodic Table of Life database. For example, if looking at building a solar concentrator based on plants, it would be valuable to collect and share information on a wide variety of applicable plants and related biological models. The data may be from literature, museums, or through measurements conducted as part of the STTR.

Proposals must demonstrate that the proposed technology complies with natural principles, patterns and mechanisms. Refer to the following sources to understand biomimetic principles.

Some resources are provided here:

- V.I.N.E. (Virtual Interchange for Nature-inspired Exploration) - <https://www.grc.nasa.gov/vine>.
- PeTaL - <https://www.grc.nasa.gov/vine/about/what-is-petal/>.
- Taxonomy tool - <https://asknature.org/>.
- Systems tool - <http://toolbox.biomimicry.org/>.

Technology is sought in the following areas:

#### **Bio-inspired resource utilization, power generation, energy storage, power management and distribution**

The NRC has identified a NASA Top Technical Challenge as the need to "Increase Available Power". Additionally, a NASA Grand Challenge is "Affordable and Abundant Power" for NASA mission activities. It is essential to be able to harness, store and distribute energy while maintaining minimal system mass and complexity. Biological models such as the oriental hornet or electric eel may be obvious candidates. Methods to improve solar cell efficiency or to create structural solar cells are of interest.

Power generation and management systems are also of interest to the growing Hybrid Gas Electric Propulsion Project under ARMD. There is specific interest in motor thermal management and low loss power distribution and storage. New concepts for electric motors and hybrid systems are desirable.

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Topics include, but are not limited to:

- Solar electric propulsion concepts (packing strategies based on nature, cell orientation/stabilization)
- Thermal management for solar electric propulsion.
- In Situ Resource Utilization using nature-inspired principles (passive, feedback controls, using local resources and energy sources, water-based chemistry and processes).
- Life support systems and personal protective equipment including anti-microbial films, first aid, radiation protection. Examples of natural models include tardigrades, structural color in butterflies/peacocks, shark skin.
- Swarm topologies, communication strategies and system dynamics applied to CubeSats or rovers.

**Cross cutting technology making use of bio-inspired processes**

Specific areas of interest include:

- Tools to aid in discovery of bio-inspired materials or technology.
- Demonstrations of advantages in mass savings made possible through bioinspired topologies enabled by additive manufacturing methods.
- Controlled synthesis of lightweight engineering materials due to bioinspired synthesis methods.