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Two UNH Faculty Receive \$1.4M In CAREER Grants From NSF

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DURHAM, NH –Two University of New Hampshire assistant professors have received prestigious National Science Foundation (NSF) Faculty Early Career Development (CAREER) grants. Vaughn Cooper of the department of molecular, cellular and biomedical sciences received \$1 million to better understand beneficial mutations in bacteria by engaging high school students in data collection. Christopher White of the mechanical engineering department received \$400,000 to research flow dynamics of liquefied biomass.

Cooper's research explores the overarching evolutionary and ecological question of how adaptation proceeds and how new mutations may benefit organisms in their current environments as well as in others. With this CAREER grant, Cooper aims to improve understanding of the relationship between adaptation to one environment and ability to grow in other environments through study of two very different types of bacteria – *E. coli* and *Burkholderia* -- evolving in laboratory microcosms. While the work has broad implications for the evolution of other species, "studying adaptation normally takes a long time, which is why we study bacteria," Cooper says.

While they're arguably the most important mutations, these beneficial mutations are rare. "The innovation of our proposal to the NSF is that we came up with a good way to find them that's easy to do," says Cooper. His project will collect many beneficial mutants from bacterial populations and precisely quantify their adaptive value in a single selective environment, then measure the scope of indirect effects of these mutants. Contemporary techniques of molecular genetics and microbiology will be used to characterize the biological networks that link genetics, physiology, and ecology in the evolving populations of bacteria.

Cooper's lab also will enlist high school students from the Seacoast School of Technology in Exeter to gather data and, he hopes, develop an interest in studying evolution in action. With a flow cytometer – a specialized microscope-like instrument that can analyze and isolate thousands of particles every second – that fits on a cart, "students will be able to pick their own mutations and characterizations, which then go into our central database," Cooper says. He hopes to take this collaboration to other area schools.

"These CAREER grants are incredibly prestigious. This grant recognizes the value of this sort of inquiry, and it places research and education in equal priority," he says.

White's research looks at the fluid physics of liquefied biomass, a key component to making biomass a viable alternative to fossil-based fuels. Biomass – waste agriculture, from manure to corn stalks – must be liquefied and refined in order to be useful as a fuel. Biomass liquefaction produces a slurry, neither solid nor liquid. "I want to understand how these slurries flow, so we can pump them from one place to another," White says. He notes that

while replacing foreign oil with biomass – the United States has set a goal of 30 percent – enhances energy security, sustainability, and environmental stewardship, the low density of biomass means that 250,000 trucks daily would need to transport biomass from its origin – usually a farm – to a biorefinery.

The logistically attractive alternative, liquefying biomass at the farm then pumping it to a centralized refinery, is complicated by the unique properties of slurry as a fluid. “It can behave more like toothpaste than water,” White says. “I’m trying to understand the rheology of liquefied biomass, the relationship between applied stress and flow.”

White, who calls the CAREER grant “a really big deal for me and a big deal for my career,” will use the NSF funding to support a graduate student working with him and to develop instrumentation and techniques that will transfer to other opaque fluids, like blood or oil.

The Faculty Early Career Development (CAREER) Program is a foundationwide activity that offers the National Science Foundation’s most prestigious awards in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization.

The University of New Hampshire, founded in 1866, is a world-class public research university with the feel of a New England liberal arts college. A land, sea, and space-grant university, UNH is the state's flagship public institution, enrolling 12,200 undergraduate and 2,200 graduate students.