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UVM tries to grasp lake's complexity

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This much can certainly be said about the University of Vermont's celebrated new multi-disciplinary research project: It's not rocket science.

Actually, it's more complex than that.

With a little fanfare, UVM staged a news conference Friday to announce a $6.7 million grant from the National Science Foundation. Sen. Patrick Leahy, D-Vt., was there, befitting his longstanding support for scientific and technical research at UVM. President Dan Fogel spoke of the exciting new three-year research project that dovetails with the university's environmental agenda. About a dozen UVM faculty in various disciplines will participate in this study, and many of them were there, too.

The grant has three parts, one of which will engage students and teachers from around the area in a study of streams, and another that will promote private-sector innovation among small businesses. The main part -- the scientific centerpiece -- will be a study of something that has already been heavily studied: the Lake Champlain watershed.

Tons of data exist on the lake and its watershed -- levels of phosphorus and aquatic life, hydrologic statistics, etc. -- gathered over many years. All of that will be primary fodder for the new study.

What makes this study different is its ambition to understand the workings of the watershed in ways no one has been able to before.

The watershed, said Judith van Houten, lead investigator and biology professor, is an example of a complex system. Such a system is really "bigger than the sum of its parts," she said, and it behaves in ways no one can predict. Properties emerge unexpectedly.

She distinguished between systems that are "complex" and merely "complicated." A watch is complicated; so is a rocket. If you remove a part, you can predict what the whole thing will do.

"However, self-organizing things like social groups of people or neural networks or watersheds, are complex," she said. "You cannot predict the outcomes from the sum of the parts."

Flocking among birds is another example. A complex-systems approach to flocking has in fact deciphered implicit rules that birds follow as they veer about in groups, said Josh Bongard, a UVM computer scientist who will participate in the watershed study. A complex-systems approach looks at the totality and tries to infer rules by studying interactions of the components. Other everyday examples of complex systems include an ant colony, or a slime mold, or a hurricane.

Armed with the reams of existing Lake Champlain data, van Houten said, "We're going to listen to the watershed. We're going to let the watershed tell us what its rules are." Facilitating this will be self-modifying programs that run the data through the Advanced Computing Center.

Beyond the watershed study, complex systems are a hot topic at UVM these days. They're the primary research focus at the College of Engineering and Mathematical Sciences. Fogel envisions complex systems research as something of a niche for UVM, with prospective opportunities across departments throughout the campus.

Developing the tools "for understanding complexity is very, very appropriate for us," he said.

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