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## **CU Denver's Randall Tagg: Helping students invent, explore** <sup>[1]</sup>

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Step into the Innovation Hyperlab at Gateway High School in Aurora and you'll find chaos. Its islands, tables, shelves and floor are filled with electronic, construction and technological stuff; lasers, compressors and sensors.

Comment to CU Denver associate professor Randall Tagg that it's chaos and he'll nod and smile.

It's like a mad scientist's garage . . . it's a lot less mad-scientist looking now than it was, said Tagg, the lab's creator. Now there is some organization to it . . . that's organization in my reference frame, most people would say it's still 'mad scientist.' We'll never get -- nor do we want to get -- fully away from that. It's 'purposeful mad scientist.'?

Tagg's students get it and so does the Aurora Public School District. The Innovation Hyperlab is chaos in its purest sense, as in the theory that combines mathematics with applications in

several disciplines including meteorology, physics, engineering, economics, biology and philosophy.

The lab's alleys, streets and islands are named for the likes of Imhotep, Cajal, Currie, Nartov and Archimedes -- significant scientists and engineers throughout history in different cultures.

About 20 high school students learn in the lab, as participants in an Innovation Academy funded through a Piton Foundation grant to Aurora and the Aurora Lights program. The lab has room for 10 more. Tagg is constructing a curriculum for grades 9-12 to use lab resources to stage courses on instrumentation and exploration in nonlinear dynamics and biophysics.

"My field is one of looking at phenomena that crosses many disciplines. It can apply to pumping stations, and it can apply to pumping hearts," he said. "We actually piloted this program already, this is our third year. We've evolved, so this year these are student-generated ideas."

The first year, Tagg provided a menu of projects for students to explore. Last year, he and his students talked to various health professionals and people related to health careers and came up with a list of projects from which students could choose.

"This year students who have been in the process as 10th- or 11th-graders can apply and become principle investigators," he said. "They propose what they want to do -- with no small amount of counseling from me. As a young person they have some general sense of what they want to do, but no experience for shaping it into a project. So that's where I come in."

One student-generated project underway is abdominal surgery in microgravity.

"Lizbeth (the student) has been shadowing or is somehow associated with a gastroenterologist as part of her desire to get into the medical profession," Tagg said. "She mentioned that she had also been exploring medicine on the moon or something, but that lighted in me an idea: OK, suppose we have a mission to Mars and there's a medical emergency and somebody has to do the surgery. How do you deal with that? Her interest in gastroenterology and my question lets us push the limit on this thing."

Other projects include musical scripting of actuator motions in biomechatronics, adaptive and biodegradable materials in orthopaedic surgery, and powering medical devices using body energy.

Students at different levels of expertise have varying options. For instance, novices and veterans can rub elbows at Nartov Way, using the traditional manufacturing or advanced manufacturing materials. Some projects are completed in the semester and are exhibited in fairs such as the Pathways celebration in April, the Rocky Vista University College of Osteopathic Medicine fair and, soon, the CU Denver Research and Creative Activities fair, of which Tagg is a founder. Other projects can carry on year after year using new student insights and advances in technology.

"The curriculum we're developing under the Gates Family Foundation is to try to expand their thinking," Tagg said. "A major role in this whole environment is to get the student involved, showing that what they can do may be varied from what the standard success story is."

CU Denver students act as mentors in the program. "It's amazing to see the undergrads who are willing to volunteer," Tagg said. "I'm just astonished. They like to come over and engage

with high school students. Teachers, coined teacher scientists in residence, are involved as well. It's a fantastic experience for undergrads thinking about teaching for a career because they're working with experienced teachers.

As the students, student volunteers and teachers evolve, so does the Hyperlab. It's going to be continued work in progress to really get it filled out, Tagg said. Basically, we have the skeleton and some of the meat on the bones and there will be more meat on the bones to come.

How much Tagg will be involved in the lab in years to come remains to be seen.

The overall time frame is to turn this whole thing officially over to Aurora Public Schools in another two-and-a-half years, he said. I hope to continue working with it, but my job in some sense is to work myself out of a job and enable teachers and people in Aurora run this lab.

The model I'm trying to create is the one I'm living, which is, I'm a university scientist who is resident in that lab. In that capacity I'd like to stay.

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#### **Intro:**

The Innovation Hyperlab is chaos in its purest sense, as in the theory that combines mathematics with applications in several disciplines including meteorology, physics, engineering, economics, biology and philosophy. See more CU outreach at CU For Colorado, <http://www.cu.edu/forcolorado>.

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