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New Research Project: Curing Cancer With Mathematics

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According to Lisette de Pillis, the secret to more effective therapies to fight cancer can be found in mathematics. A cancer researcher and mathematics professor at Harvey Mudd College in California, de Pillis is leading a team that is developing and testing new mathematically optimal approaches to controlling multiple simultaneous cancer treatment strategies, which include chemotherapy, immunotherapy and vaccine therapy.

Professor de Pillis and her team will present their National Science Foundation-sponsored research project "Curing Cancer with Mathematics" at the 13th annual meeting of the Coalition for National Science Funding on Tuesday in Washington, D.C. The event will be held at 5:30 p.m. in the Rayburn House Office Building on Capitol Hill. (See information below).

"We have developed a series of specific mathematical models to address cancer cell division rates and other components," says de Pillis. "What is exciting about this work is that we are actually able to go beyond this, as we seek to capture in our mathematical models the complex dynamics of the interactions among cancer cells, our immune system, and medical treatments."

She says the mathematical tools she and her team are developing will help determine best treatment practices through simulated experiments at no risk to patients. "They can also allow us to customize treatments for individuals," she says. "The simulations, geometric visualization and treatment optimization tools we have created allow for virtual (computational) experiments to be run in a variety of cases."

For example, de Pillis notes, an important but open question is how best to combine multiple cancer treatments in one patient. "Should we first boost the immune system, and then give toxic chemotherapy, should we give big doses of one treatment and small doses of another and how should we combine such treatments, how long should we wait before re-administering a toxic treatment?"

Through her team's use of mathematics, she says: "We can gain insight into how to answer some of these questions, since computational experiments testing various cases can be performed quickly, and with no risk to living persons. Additionally, these mathematical and computational tools should even allow us to tailor treatments to individual patients, something that is not commonly done in medicine today."

"Curing Cancer With Mathematics" Will Be Theme of Research Team's Presentation in Nation's Capital

Members of a Harvey Mudd College (HMC)-led research team will present their research "Curing Cancer with Mathematics" at the 13th annual meeting of the Coalition for National Science Funding (CNSF) on Tuesday, June 26, in Washington, D.C. Leading the team will be Lisette de Pillis, HMC professor of mathematics, who is lead principal investigator (PI) on the National Science Foundation (NSF)-sponsored research project. The team is working to develop and test models of cancer growth and to implement mathematically optimal approaches to controlling multiple simultaneous cancer treatment strategies, which include chemotherapy, immunotherapy and vaccine therapy.

According to de Pillis: "Harnessing the power of the body's own immune system is a promising approach to combating a growing cancer. However, precisely how cancer immunotherapies work, and how they should be administered optimally, either alone or in conjunction with chemotherapies, remains an open question of great interest and import to the medical community.

"In this cross-disciplinary project, we are developing computational and mathematical tools capable of modeling the complex cascade of biological tumor-immune interactions, and of determining effective combination treatment strategies. Our tools have the potential to provide clinical guidance in the development of new treatment protocols through preliminary evaluations of simulated scenarios."

The project and team were selected to represent the Mathematical Association of America (MAA) at the CNSF exhibition in Washington, D.C., where they will showcase the kind of active research that takes place with undergraduates at HMC. Harvey Mudd College was named by the MAA to receive its first Exemplary Program in Mathematics award in 2006.

HMC Associate Professor of Mathematics Weiqing Gu is a co-PI, bringing to the project her expertise in analytic geometry, and Renee Fister from Murray State University (KY) is the other co-PI, bringing her expertise in optimal control theory. Also representing the HMC will be students and recent graduates of

Harvey Mudd College: Benjamin David Preskill '09 of Claremont, David Gross '08 of Pasadena, Calif., and James Moore '07 of Mercer Island, Wash.

Since 1995, the Coalition for National Science Funding (CNSF) has sponsored an exhibition and reception each spring, showcasing research made possible by the National Science Foundation. Exhibit booths display a wide range of scientific research and education projects and university researchers and educators are on hand to describe their work to interested members of Congress and their staffs.

Harvey Mudd College (http://www.hmc.edu) is a national leader in undergraduate education in engineering, science and mathematics, with a strong emphasis on humanities and the social sciences. The college's mission is to produce citizens sensitive to the impact of their work on society. Harvey Mudd College is a member of The Claremont Colleges consortium, which also includes Claremont Graduate University, Claremont McKenna College, Keck Graduate Institute of Applied Life Science, Pitzer College, Pomona College and Scripps College.

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