



# Using Math to Support Cancer Research

Cancer research is a crucial job, but a difficult one. Tumors growing inside the human body are affected by all kinds of things: oxygen delivered by blood, energy delivered in the form of glucose, not to mention the myriad other cells and chemicals in the surrounding environment. These conditions are difficult (if not impossible) to recreate in the lab, and using real patients as subjects can be painful and invasive. Mathematical models give cancer researchers the ability to run experiments virtually, testing the effects of any number of factors on tumor growth and other processes — using far less money and time than an experiment on human subjects or in the lab would use.

But these models don't work in isolation. They rely on real-world data, and their predictions must be carefully tested for accuracy using experiments and clinical trials.

**Example:** In one exciting potential advance, laboratory scientists grew tumors surrounded by a new type of cell. Mathematical modelers then used data gathered from studying them to simulate what would happen under various conditions. The results suggest that the tumor's growth might be halted with a drug that's already been invented — speeding up the timeline for patients to benefit from this research. Now, clinical trials must be done to ensure the model's results translate to the real world.

In a different study, Colin Cess and Stacey Finley used a computational model to predict what happens when a tumor is treated with nothing (left), with chemotherapy (center), or with a drug that prevents blood vessels from reaching the tumor (right). Dead cells are shown in black; live cells in gray; yellow cells migrate more freely.

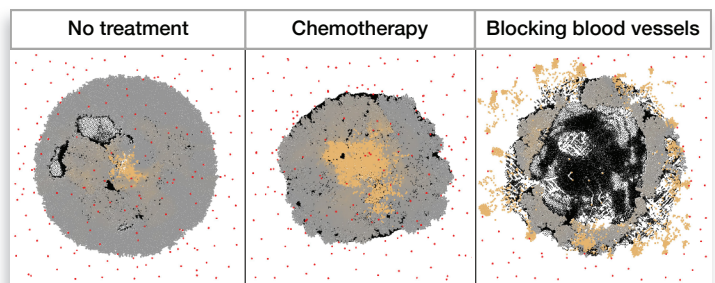


Image taken from: Cess, C. G., and Finley, S. D., Multiscale modeling of tumor adaption and invasion following anti-angiogenic therapy. *Comp. Sys. Oncol.* 2 (2022), e1032. <https://doi.org/10.1002/cco2.1032>. Licensed under CC BY 4.0.

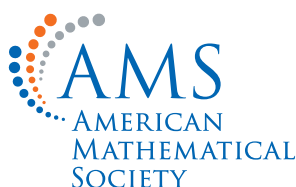
**References:** Araujo, R.P., McElwain, D.L.S. A history of the study of solid tumour growth: The contribution of mathematical modelling. *Bull. Math. Biol.* 66, 1039–1091 (2004).

Wang, J., Delfarah, A., Gelbach, P. E., Fong, E., Macklin, P., Mumenthaler, S. M., Graham, N.A., Finley, S. D. Elucidating tumor-stromal metabolic crosstalk in colorectal cancer through integration of constraint-based models and LC-MS metabolomics. *Metabolic Engineering* 69, 175–187 (2022).

Watch an interview with an expert!



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