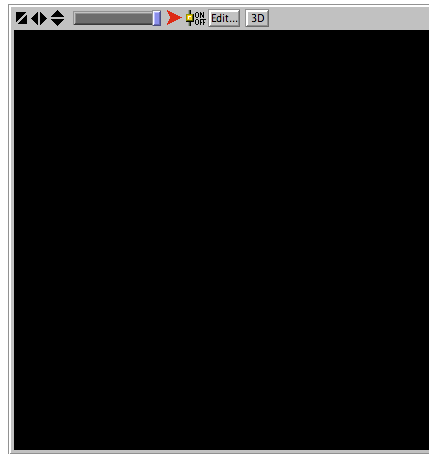


## Opening the Black Box with NetLogo



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I called the talk “Opening the Black Box” because I find that many students never see computer models as something that they could inspect critically or modify or adapt to novel circumstances. This talk is about a tool called “NetLogo” which is useful for getting students to work with computational models.

## Computational Modeling A,B,C's

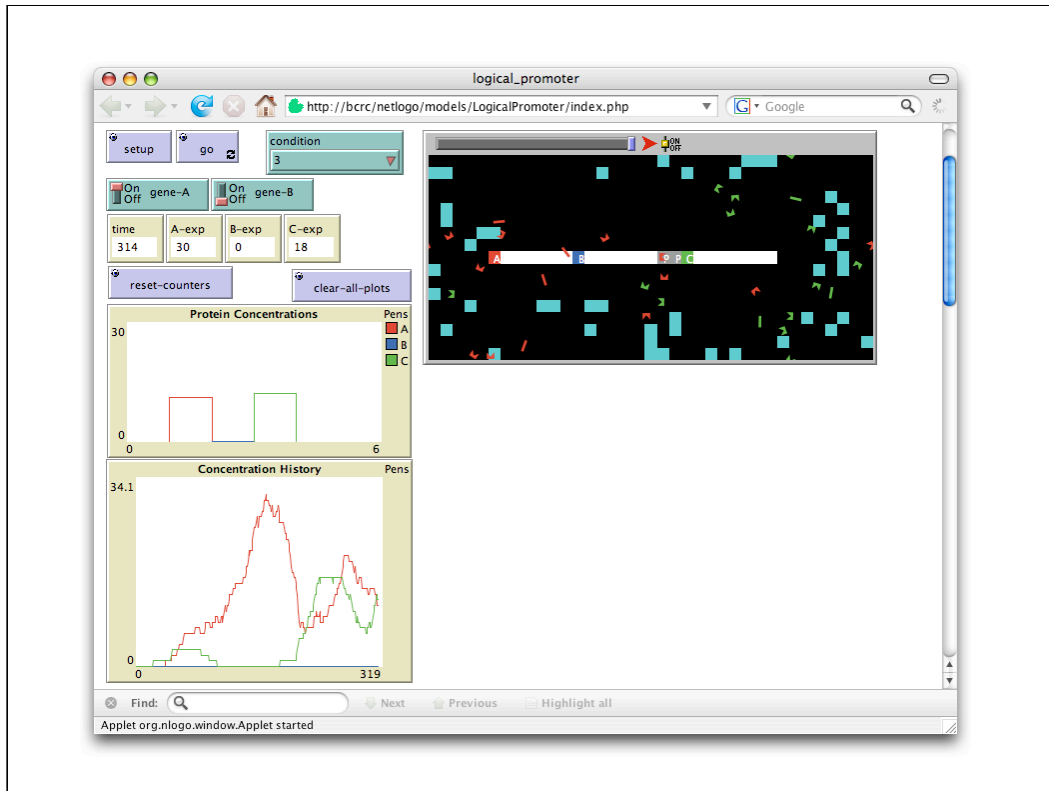
- \_ Wolfram's "New Kind of Science":  
computation as the new mathematics.
- \_ Computational models increasingly used  
in science, as well as all other disciplines  
(economics, management, etc)
- \_ Students need explicit experience to
  - Critically use computational models
  - Elaborate and extend existing models
  - Apply computation to solve new problems

Steven Wolfram wrote a book called "A New Kind of Science" which describes computation as the new holy-grail of scientific inquiry. It used to be that equations were the ultimate goal of science, but increasingly rule-based programs have more predictive and explanatory value. They're being used everywhere for decision-making and our students need to learn how to use them critically (esp. to recognize their limitations) and become fluent with revising and repurposing them (esp. to be able to use them as a filter for understanding which observations can be explained by the model and which represent new information).

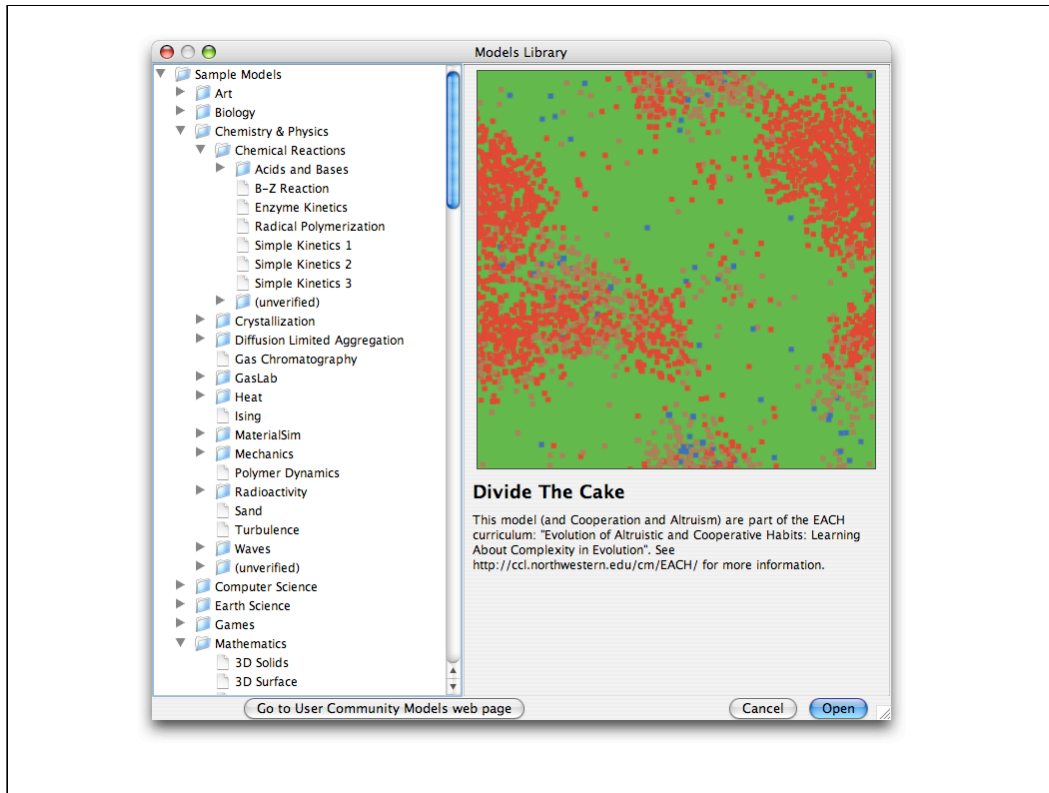
## What is NetLogo?

- \_ Free Java-based modeling software
- \_ Easy-to-learn (Based on Logo programming language)
- \_ Uses interacting population of programmable “agents” to simulate emergence of complex behavior
- \_ Product of the Center for Connected Learning and Computer-Based Modeling
- \_ Descendant of “StarLogo” from MIT Media Lab

In addition to being easy-to-learn, many students (maybe one-half to two-thirds) actually studied logo in elementary or middle school.



This is one of several models I wrote that we're currently using in Intro Biology. This model represents three genes (A, B, and C) where one gene (C) is controlled by the binding of the products of the other two genes. Genes produce RNAs (the little sticks) which bump into ribosomes (the blue squares) and are translated into proteins (the red and green squiggles). You can see A bound to a promoter site which is evidently enough for C to be "on". Students can collect quantitative data to compare the operation of the system under different conditions. We use these models in conjunction with data collection of in-vivo systems.



There are already a lot of models in many disciplines – and there are whole curricula in chemistry and physics (and a variety of biological models, especially in evolution and ecology). The models I've written are essentially the only models in molecular and cellular biology, however. It might be possible to leverage the toolbox I've developed to pursue funding to develop a curricula for molecular and cellular biology. But I actually had a more ambitious goal in presenting this talk.

## I propose NSM use NetLogo to...

- \_ Illustrate basic concepts in introductory classes across the college.
- \_ Challenge students in intermediate classes to elaborate or extend models.
- \_ Provide opportunities to advanced students to construct independent models.

If all of the departments in NSM used NetLogo as a common modelling environment, we could provide students with opportunities to not only \*use\* models, but to elaborate and extend models – and to construct new models to explore novel problems. Our students would be almost uniquely empowered for a future in which computational modeling is almost certainly going to be increasingly important for decision-making in all disciplines. A grant from the NSF CCLI Adaptation and Implementation track might be one mechanism for funding this project.