Secret Agents, Super Models: Agent-Based Modeling

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Our Group Objectives

- Use agent-based models (ABM) as a tool for students to visualize & analyze biological processes
- Serve as a support group
  - Technical
  - Pedagogical
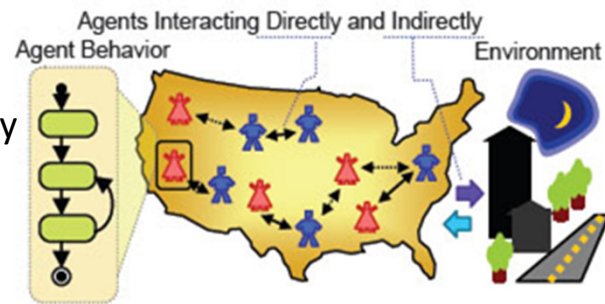- Each member will develop, pilot, and evaluate a curriculum module

What is Agent-Based Modeling?

Keep track of individuals as they follow certain rules to interact with other individuals and their local environment

- Agents vary (size, location, resources, history, age)
- Interactions are local (spatially explicit)
- Adaptive, objective-seeking behavior

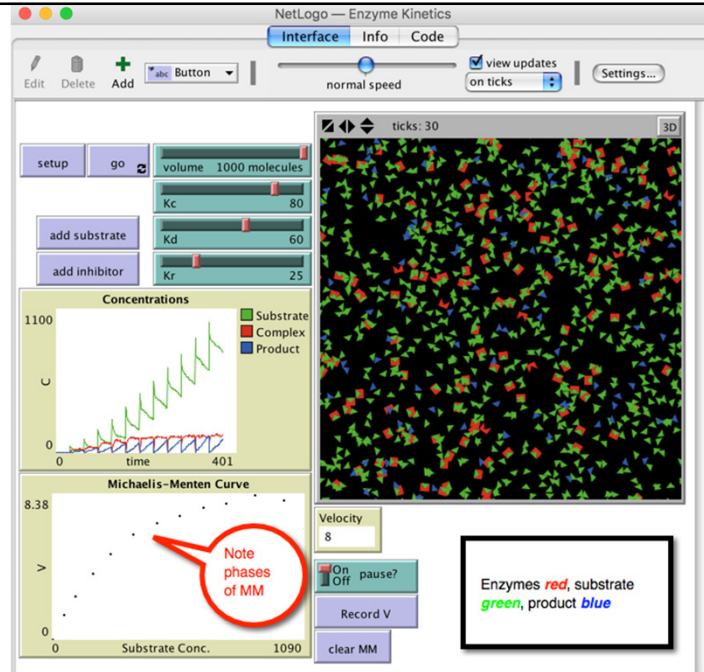System/population level patterns

NetLogo for Education

- Easy for students to
    - Manipulate parameters
    - Visualize system
    - Generate data/graphs
- Lots of pre-built models (some with great documentation)
- Relatively easy to customize for specific purposes with coding
- Lots of resources for use and education
- Inherently stochastic behavior
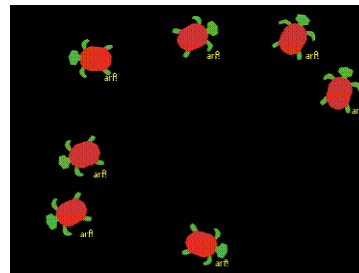
Enzyme Kinetics Model (John)

Allow students to characterize and evaluate the effect of varying the rate constants associated with E ↔ ES → E + P. Students will be able to explain what K_m and V_{max} means.

Vary the ratio of rate constants for association (ES) to dissociation (free E + S) to estimate binding affinity of substrate to active site. How does this change with a mutation in the enzyme? Students should be able to recognize that mutations often reduce binding affinity and should be able to give two possible reasons for the change in binding affinity.

Evaluate the effects of competitive vs noncompetitive inhibitors, where students will be able to graphically illustrate the effects of inhibition on V_{max} and K_m and verbally explain what this means.
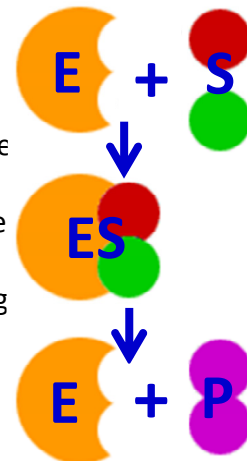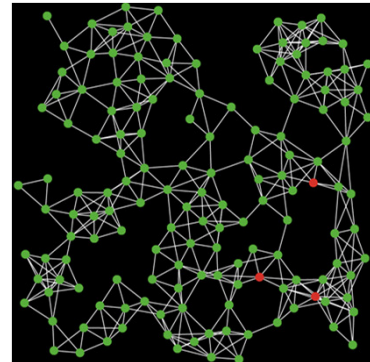
Epidemic Simulation (Celeste)

Relate NetLogo model to live-action simulation

- Diff. levels of contact between indiv. students
- Track overall course of epidemic based on...
  - Rate of transmission
  - Relationship status between indivs.
- Graphical analysis of network structure
- Final product evaluation and presentation

Genetic Drift Module (Tony)

- How does **genetic drift** differ from **gene flow**?

- What specific processes contribute to genetic drift?

- Why is drift inevitable in any real biol. population? In what pops. is it likely to have greatest impact, and why?

- Given that drift is random, how can one make predictions about its likely outcomes?
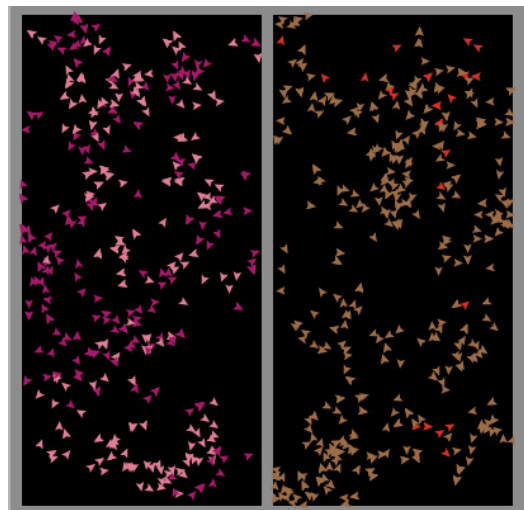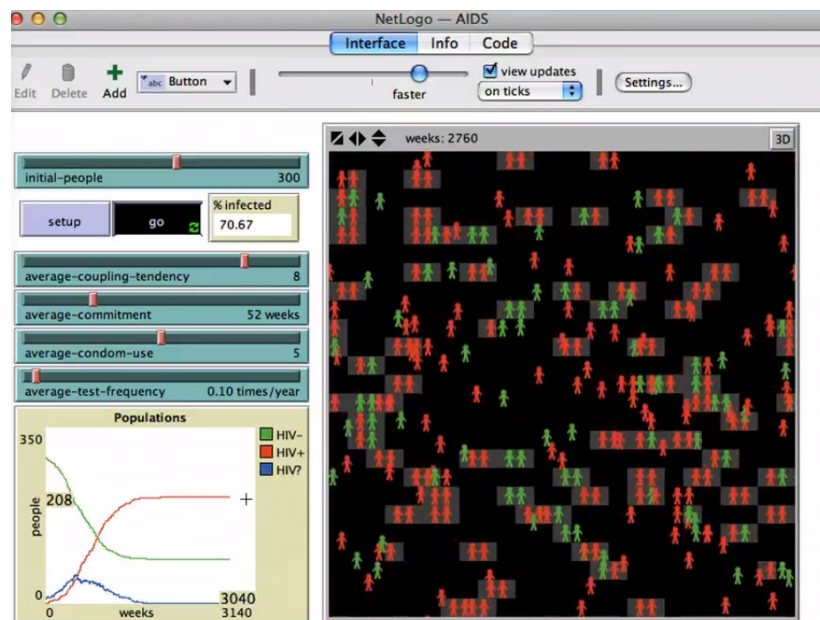
Case Study with ABM (Kristin)

Goal: Develop, implement, and hopefully evaluate a module that:

- Introduces mathematical modeling and specifically ABM
- Focuses on an interesting case study
- Uses active learning strategies
- Helps students understand some difficult biological concept
- Include formative & summative assessment
- Specific topic & setting open for suggestions & collaboration
  - Genetic drift with Florida panthers with Tony?

Click image for demo on Youtube