Name: Evan Brauer
Grade level(s)/Subject taught: High School
Objectives: 1. To determine the characteristics of an ecosystem given specific organisms and their behaviors. 2. To model the behavior of this ecosystem through the use of Agentsheets.

1. *Write* the Mathematical Concept or "key idea" that modeling will be used to teach: (e.g. Students use mathematical modeling/ multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships)

Students use mathematical modeling/ multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships Students use ideas of uncertainty to illustrate that mathematics involves more than exactness when dealing with everyday situations.

Materials:

Computer with Agentsheets

Using Agentsheets I plan on having my students…

The lesson will begin with a class discussion on zebra mussels. We will ascertain what prior knowledge exists in the classroom, and what blanks need to be filled in through a large-group discussion. The key components that need to be addressed/discussed are:

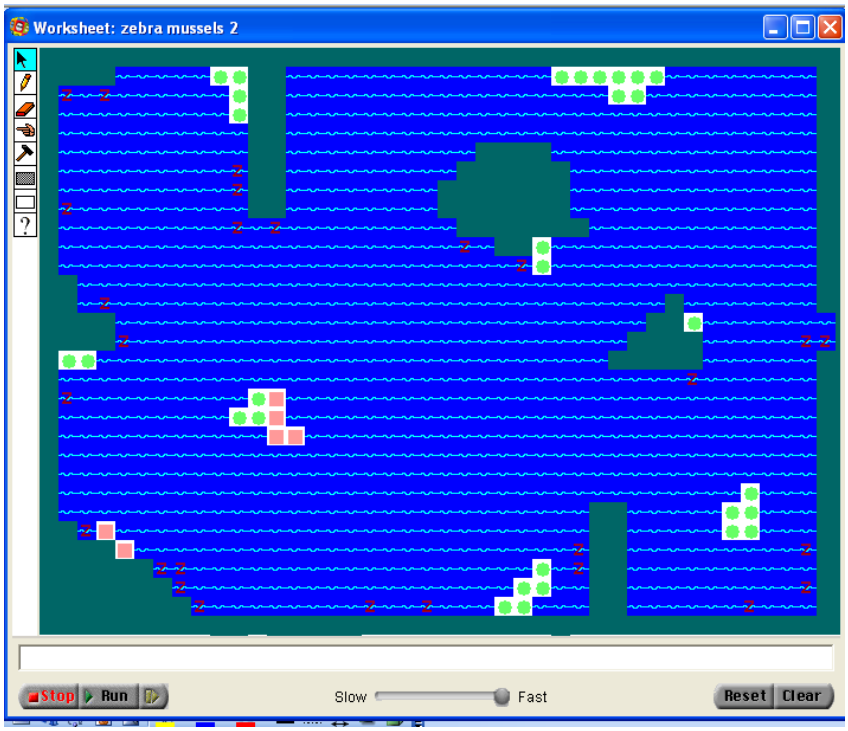
- Zebra mussels are an invasive species – very bad
- They populate along the shores (mostly) of lakes, adhering to almost any stable part or surface.
- They can move
- They reproduce
- They eat plankton
- There is no known predator of the zebra mussel

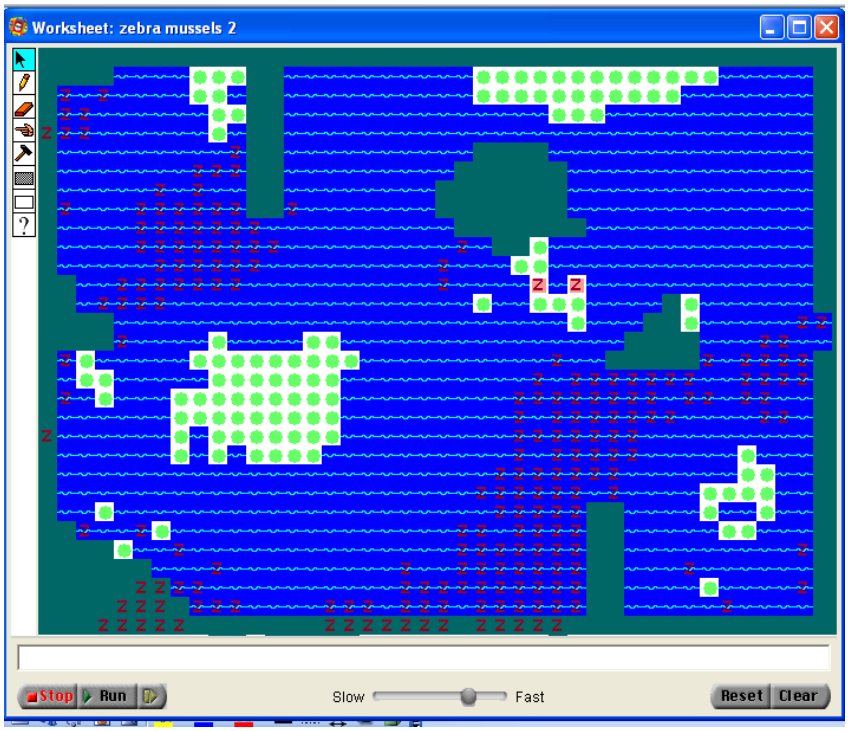
We will then create an ecosystem that could model these characteristics. Discussion will be centered on how we could visually observe zebra mussels increasing in population size, eating plankton and moving through the lake. This will be done using Agentsheets.

Assuming the students have little or no prior knowledge of this program, much of the actual programming will be teacher-led, though the students will be responsible for determining the parameters of each organism. We will discuss how each organism should behave, what characteristics are necessary, and then how to write the rules in Agentsheets. The behaviors needed are:

1. A lake, surrounded by land.
2. Zebra mussels that can move and reproduce (with a probability less than 1)
3. Plankton that is killed when eaten by zebra mussels, turning into water.
4. Plankton that reproduces (with a probability less than 1)
5. Plankton that moves (with a probability less than 1)

We will then create the actual Agentsheets project and model the behavior written, changing placements and probabilities. Some examples are shown below.





A homework assignment would be given that asks the students to change some initial populations and behaviors and observe what effects these changes have on the ecosystem. What does an increase in the number of mussels, along with a decrease in their ability to move and reproduce, do to the system? If we add a new agent, say a chemical that can kill the mussels, does the spread of the mussels change, causing a change in the plankton growth? Other questions could be added which would allow the students to model many different scenarios. A rubric for this assignment is found on the following page.

DISCUSSION OF RESULTS RUBRIC

Attributes	Above Standard	At Standard	Attribute Still A Goal	Attribute Points Earned
	(5-4.5)	**(4-3.5)**	**(3-0)**	
Procedure and Tested Variable Summary	The project and tested variables are elaborately summarized .	The project and tested variables are briefly summarized.	The project and tested variables are not summarized completely or are not present.	**/5**
	(5-4.5)	**(4-3.5)**	**(3-0)**	
Relationship Identification	Discovered relationships are clearly identified, follow logically from gathered data, and are accompanied by accurate equations.	Discovered relationships are clearly identified, follow logically from gathered data, and accompanied by an equation that partially matches the gathered data.	Discovered relationships and equations are not clearly identified, inaccurate or missing.	**/5**
		(5-3.5)	**(3-0)**	
Relationship Examples		At least **two** data points per relationship are quoted to exemplify stated relationships.	Supporting data points are missing or incomplete.	**/5**
	(5-4.5)	**(4-3.5)**	**(3-0)**	
Relationship Model	Used and accurately applied their mental model of the world to postulate a physical explanation for findings.	Used and incorrectly applied their mental model of the world to postulate a physical explanation for findings.	Little or no attempt to apply thier mental model of the world was present.	**/5**
	(10-9)	**(8.5-7)**	**(6.5-0)**	
Relationship Focus	Identified relationships focus on the answer to the main question(s) identified in the project's purpose and are connected to the larger context of their topic of study.	Identified relationships mostly focus on the answer to the main question(s) identified in the project's purpose and are connected to the larger context of their topic of study.	Identified relationships have little or no connection to the project's purpose nor to the larger context of their topic of study.	**/10**
	(5-4.5)	**(4-3.5)**	**(3-0)**	
Errors	Errors are clearly identified and the impact of these errors on data and conclusions are also identified and discussed.	Errors are clearly identified.	Errors are not clearly identified.	**/5**
		(5-3.5)	**(3-0)**	
Project Extensions		Ideas for future study of the project's topic along with suggestions for the project's improvement are	Few or no ideas for future study of the project's topic along with suggestions for	**/5**

		identified.	the project's improvement are present.	
Total Conclusion Points Earned				**/40**