Our proposed plan

We will....

◆ program several mathematics centric games and simulations;
◆ identify the ways in which students' understanding of mathematics can be enhanced and deepened;
◆ brainstorm ways mathematics classrooms can use programming for projects in data analysis, probability and algebraic reasoning.
Three types of math + programming activities

1. Focus on math in the context of games & sims

2. Using programs to generate mathematical data, patterns, etc.

3. Math explicit activities
Math in the context of game design

Frogger game in ACO (Courtesy of Jeff Bush)

https://www.agentcubesonline.com/project/848477
If you can build Frogger, can you make a simulation?
Mathematics generated by sims

https://www.agentcubesonline.com/project/848146
Use the Ecosystem Sim

• Open the simulations properties
• Run the simulation to generate data
• Export to Excel or Google Sheets
• Create a plot of the data
Three types of math + programming activities

1. Focus on math in the context of games & sims

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3. Math explicit activities
Common Core State Standards Mathematical Practices

- Make sense of problems and **persevere in solving** them
- **Reason abstractly** and quantitatively
- **Model** with mathematics
- **Construct viable arguments** & critique the reasoning of others
- Use **appropriate tools** strategically
- Attend to **precision**
- Look for and **make use of structure**
- Look for and express regularity in **repeated reasoning**
Programming & mathematics

Abstraction
Logic
Representation
Connections
Problem Solving
Structure
Learning math through programming
indirect but often essential

1. **Valid mathematics instructions**
2. **Sense making with math content**
3. **Seeing and building patterns**
4. **How repetition changes values**
5. **Where are you? (coordinates)**
Learning math through programming explicit content

1. Understanding Variables
2. Recursion (assignments like $x = x + 1$)
3. Equality, Inequality, Not equal
4. Math concepts embedded in formulas
5. Probability and randomness
6. Representing linear, exponential and other functions
Making Math Explicit

Mathematics resources for Agentsheets

Google Search:
Agentsheets Reference Manual
{page 134 – math formula syntax}

Mathematically explicit activities

Recommend focusing on the following content:

• Probability and data analysis
• Patterns and functions
• Modeling in mathematics
Interpreting Linear Functions

Warm Up: Write a story that could be represented by this graph.

Ex: Sally is 16 today! Her dad takes her to test drive a brand new red convertible. At a stoplight, Sally quickly accelerates to 100 miles per hour and maintains that speed for a while to the horror of her father! She sees the dealership in sight and skids to a halt. Dad decides that Sally is not ready for a new car.
Use AgentCubes to tell a story and program it according to that story.

Ex: Jimmy the Butterfly is trying to reach his favorite petunia bush. However, he first has to journey from his current location in the shrubs to the bush. He first flies rapidly in a direction where he encounters a forest on a mountaintop. He has to slow down to dodge trees. He then makes it out of the forest to where he stops to smell the flowers (not the ones he wants though!) He then sees his favorite petunia bush and races to it!
Make a corresponding graph that models that story. Ex: Jimmy’s Journey
Interpret the slopes of parts A (in red), B (in blue) and C (in green) of your graph. Make sure to label your x and y axis with whatever units you think make sense!

What are the slopes of line segments A, B and C?

Write linear equations that could model each of the three line segments A, B, C.

Describe an appropriate domain for each of the linear equations you wrote in part.
Monica is on a mountain bike ride. The graph above shows her mapping the distance of her trip and the elevation she gained during the ride. Design another graph that showing how the speed might change over the course of the nine miles.

Program a story in AgentCubes associated with your graph. Include agents that fit the characters and objects of your story.

What additions or changes should I make to this activity?
Representing Probability

Use edit to play and read through the code

https://www.agentcubesonline.com/project/846287
Exploration of transformational geometry

https://www.agentcubesonline.com/project/833845

https://www.agentcubesonline.com/project/850911
Your turn

Create a mathematical activity that involves creating and programming agents.

Consider: What are your project goals?
• What should the agents look like and do?
• What should the user be able to see and do?

Think about: What are the mathematical goals?
• Standards for Math Practice?
• Grade level content?
Debrief

1. Briefly describe your mathematical activity.
2. How far did you get? Possible next steps?
3. Tell us something you learned, or a challenge you encountered?