Build a Simulation

Independently program a simulation.

This activity tasks a student to create his/her own simulation of any real-world situation.

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Lesson Objective:

This lesson tasks students with creating a simulation of a real-world situation using basic and more advanced programming skills.

Prerequisite Skills:

- **Students are presumed to have successfully completed the following activities:**
  - **Frogger**
  - **Journey or PacMan**
  - **Contagion**

Length of Activity:

- **Five 30-45 minute lesson**

Computational Thinking Patterns:

- **Cursor Control**
- **Generate**
- **Absorb**
- **Collision**
- **Transport**
- **Polling**
- **Hill Climbing**
- **Diffusion**

Activity Description:

- **Teacher instructions**
- **Student instructions**
- **Rubric**

Build a Simulation

Table of Contents

Build a Simulation

Teacher Instructions - Create a simulation

A. Review the Student Instructions. Determine ahead of time what the minimum number will be for each requirement, as well as any other requirements you will expect.

The assignment:

Now it is your turn to create your own simulation. Again, you can build it to simulate **any** real world situation. But you MUST include as many details as you can so that it is as realistic as possible. It must include the following requirements as specified by your teacher:

- ☐ At least ___ agents
- ☐ At least ___ agent attributes
- ☐ At least ___ simulation properties
- ☐ Data must be graphed
- ☐ Simulation topic must be pre-approved
- ☐
- ☐

It must run without any user controls. That means that no agents should be cursor controlled – instead the simualtion should run on its own, and stop automatically at a logical point. Stoppping at a logical point for our example simualtion (the washing machine) means it stops when the clothes are clear and the water drains.

- ☐ You must also document the simulation by writing a report. The report must include the following information:

    - A description of the situation being simulated, with as much detail as possible.
    - A description of each agent and its behaviors
    - A description of the worksheet
    - A description of all variables that were included in the simulation
    - A description of any variables that were not included in the simulation, and why those variables were excluded.
    - A description of two specific portions of coding that were critical to the development of this simulation.
    - A description of how changing the variables changes the overall simulation.

B. Determine if you will have students read through the sample simulation story, or whether you will discuss a simulation as a whole class discussion. If students will work through the

sample simulation on their own, then pass out the student instructions. If you will use the sample simulation as a whole class discussion, begin that now by suggesting that you are going to create this simulation. Ask them to help you plan it. Guide the discussion to help students see the level of complexity required in the simulation.

C. After students have read the sample simulation or completed the class discussion, it is time for them to choose their own simulation.
    a. Allow students to talk with the person next to them about the assignment for the first ten minutes. This gives students a chance to brainstorm ideas and think through their plan.
    b. Have students work independently for a set amount of time (perhaps 15 minutes). This time should be spent documenting their plans. This should include sketches of proposed agents, descriptions of code, and explanations of what will be included in the simulation. Allow them to 'phone a friend' (talk with another student in the classroom) if they are stuck. After 5-10 minutes, have students work independently again.
    c. Continue to foster time for students to talk through their simulation with another student. Even if students work in pairs, consider providing time for students to share their ideas with other pairs.

D. A rubric is provided for grading. Be sure to provide the rubric to the students at the start of the project.

Student Instructions - Create a simulation:

The background:

You have been tasked with creating a simulation of a real-world situation. To get you thinking creatively, first read through this story about two students who wanted to build a simulation of a washing machine.

Sarah and Josh decide to create a simulation of a washing machine. As they sat down to get ready to program the simulation, they quickly realized that first, they needed to think through what a washing machine really does. Their first description looked like this:

> Clothes go into the washing machine. It fills up with water, and washes them. Then the clothes get clean.

So they programmed this simulation. It had a box that was the washing machine, with many clothes agents in the box. A water agent generated new water until it was full. Then the students used the Computational Thinking Pattern ABSORB to make the water disappear.

When they showed it to a friend, however, they realized there was still more to do! The friend asked them questions, like…

- *Can you heat the water?*
- *Where is the soap?*
- *How do you know the clothes are dirty? How do you know they are clean?*
- *Don't the clothes move around in the washer?*

With those questions swirling in their minds just like the clothes that should be swirling in the washing machine, the two students got back to work. Their first step was to add a heater to heat the water. Yet they had no idea where a heater might be located in the washing machine! They took a break from programming to do some quick research on the internet. They learned that the hot water came in hot from the house pipes – there was no heater in the washing machine! Once they knew how the machine worked, they talked through the other questions. They decided to add soap to the simulation, and to add a 'rinse' cycle to the washing machine. They also decided to create an agent property called cleanness that would be big for really dirty clothes, and would count down to zero when the clothes were considered to be 'clean.' They also decided to show the clothes moving around in the washing machine, and to show that the dirt was moving from the clothes into the water. Now their description was more specific.

> Clothes go into the washing machine and soap is added. The washing machine fills up with water, and the clothese move around in the water. The soap helps the dirt come off the clothes and go into the water. An agent property called 'cleanness' will count down to simulate the time it takes to get the clothes clean. The washing machine drains and then refills with clean water to rinse the clothes. The washing machine drains again, and the clothes are clean.

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  - A description of the situation being simulated, with as much detail as possible.
  - A description of each agent and its behaviors
  - A description of the worksheet
  - A description of all variables that were included in the simulation
  - A description of any variables that were not included in the simulation, and why those variables were excluded.
  - A description of two specific portions of coding that were critical to the development of this simulation.
  - A description of how changing the variables changes the overall simulation.

Good Luck!

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RUBRIC

Simulation:	Below Expecatations	Meets Partial Expectations	Meets All Expectations	Exceeds Expectations
At least ___ agents	Agents missing	Agents are not appropriate color and shape	Agents are appropriate color and shape	Additional agents are created as an integral part of the simulation
At least ___ agent attributes	No agent attributes	Agent attributes are created but not used in the program	Agent attributes are created and used appropriately	Agent attributes are used in unique or sophisticated ways
At least ___ simulation properties	No simulation properties	Simulation properties are created but not used in the program	Simulation properties are created and used appropriately	Simulation properties are used in unique or sophisticated ways
Data must be graphed	Data is not graphed	Data is graphed but there is an error	Data is graphed	N/A
Simulation topic must be pre-approved	Simulation is not approved	N/A	Simulaton is approved	N/A
Other teacher requriements				
Simulation runs independently	Simulation is cursor controlled	Simulation is not cursor controlled but does not run independently	Simulation runs independently	N/A
Simulation ends at an appropriate point	Simulation does not end	Simulation ends at an inappropriate point	Simulation ends at an appropriate point	N/A

Build a Simulation

Report	Below Expecatations	Meets Partial Expectations	Meets All Expectations	Exceeds Expectations
A description of the situation being simulated, with as much detail as possible.	Description missing	Description is minimal, key details missing	Description is present with appropriate details	Description is very detailed
A description of each agent and its behaviors	Description missing	Description is minimal, key details missing	Description is present with appropriate details	Description is very detailed
A description of the worksheet	Description missing	Description is minimal, key details missing	Description is present with appropriate details	Description is very detailed
A description of all variables that were included in the simulation	Description missing	Description is minimal, key details missing	Description is present with appropriate details	Description is very detailed
A description of any variables that were not included in the simulation, and why those variables were excluded.	Description missing	Description is minimal, key details missing	Description is present with appropriate details	Description is very detailed
A description of two specific portions of coding that were critical to the development of this simulation.	Description missing	Description is minimal, key details missing	Description is present with appropriate details	Description is very detailed
A description of how changing the variables changes the overall simulation.	Description missing	Description is minimal, key details missing	Description is present with appropriate details	Description is very detailed
Overall Evaluation				
Simulation depicts a real-world situation	Situation does not depict a real world situation	Simulation depicts a real-world situation, but it is not an appropriate situation	Simulation depicts an appropriate real-world situation	Situation is unique
Simulation is appropriately realistic	Simulation is not a realistic depiction of the situation	Simulation is somewhat realistic, but is missing key details	Simulation is realistic and contains appropriate details	Simulation is very realistic and contains more details than expected.