



Creating “Contagion”

A virus is infecting your world. As people move randomly and come face to face with a sick person, they too become sick. Learn more about how illnesses can spread through this simulation.

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This curricula has been designed as part of the Scalable Simulations Design project.
It was created using ideas from and portions of prior work completed by
Fred Gluck.

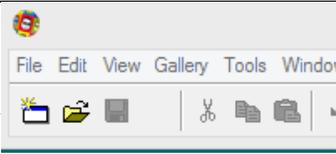
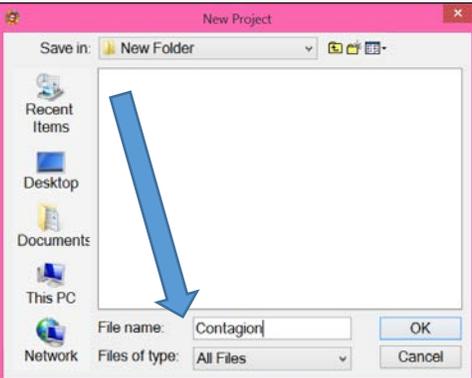
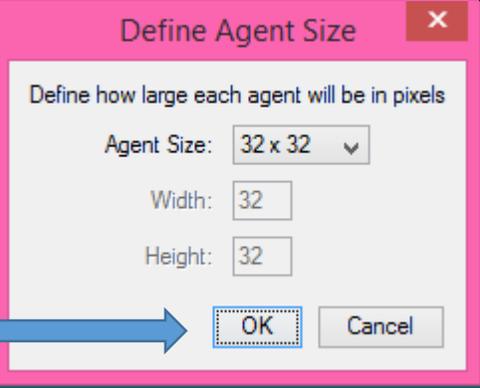
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Vocabulary/Definitions

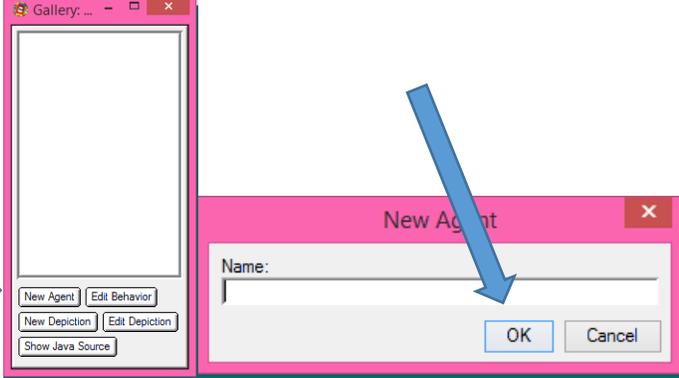
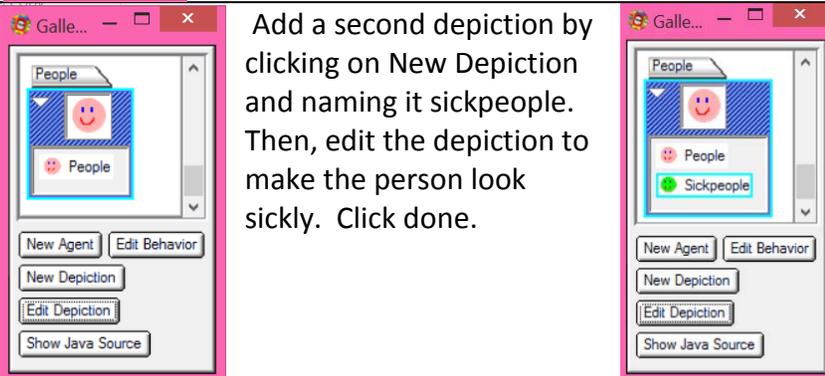
- Agent Attribute**.....an assigned feature of an agent (such as scent)
- Algorithm**a set of instructions designed to perform a specific task.
- Brackets**method of setting information apart using “[“ and “]”
- Broadcast**A way for agents to communicate with other agents that are not adjacent to them - agents broadcast (or send out) a signal
- Collision**.....an event wherein two agents interact when next to each other.
- Decrement**to decrease by one
- Diffusion**the process in which an attribute moves from areas of strong concentration to weak concentration
- Increment**to increase by one
- Hill Climbing**a specific form of searching/seeking technique, or algorithm, by which the seeking/searching agent uses information (agent attribute) embedded in the floor.
- Method**.....a set of rules to follow in a specific situation
- Parentheses**method of setting information apart using “(“ and “)”
- Polling**.....the process of contacting and communicating with each agent
- Propagated**the spreading of an agent attribute
- Randomly**to occur in non-systematic ways
- Rule Order**the order in which rules are placed for each agent
- Simulation Property**.....an attribute (value) accessible by all agents.

Student Handout 1C: Create basic Contagion

Part 1: Create Agents

<p>Step 1</p>	<p>Create Simulation</p> <p>Click on the new simulation icon (far left)</p>	
<p>Step 2</p>	<p>Name the Simulation</p> <p>Name it Contagion and click OK</p>	
<p>Step 3</p>	<p>Define Agent Size</p> <p>Do not change - Click OK</p>	

Contagion (Continued)

<p>Step 4</p>	<p>Create Agent</p> <p>Click on New Agent</p> <p>Name it Contagion</p> <p>Click ok</p>	
<p>Step 5</p>	<p>Edit Agent</p> <p>Click Edit Depiction</p> <p>Click Clear to erase the current image.</p>	 <p><i>Click on Color> Mask Color>> White to make the white background sections see-through</i></p>
<p>Step 6</p>	<p>Draw the ground as a solid color.</p> <p>Click Done</p>	
<p>Step 7</p>	<p>Draw the person with two depictions.</p>	<p>Add a second depiction by clicking on New Depiction and naming it sickpeople. Then, edit the depiction to make the person look sickly. Click done.</p> 

Part 2: Create the Worksheet

Select Tool

Pencil Tool – places a single agent on the worksheet

Eraser – erases agents from the worksheet

Will be defined later

Will be defined later

Draw Rectangle – places agents in an array (rectangle)

Erase Rectangle – erases agents in an array

Will be defined later

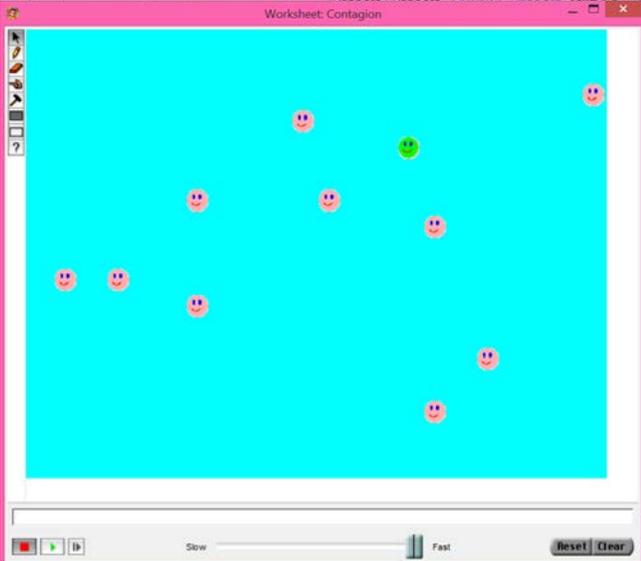


The worksheet is the simulation space –

it is where the agents will perform their actions.

<p>Step 8</p>	<p>Make the worksheet</p> <p>Click File>>New Worksheet</p>	
<p>Step 9</p>	<p>Make the worksheet bigger</p> <p>Notice it is big, but not so big that it fills up the whole space.</p>	

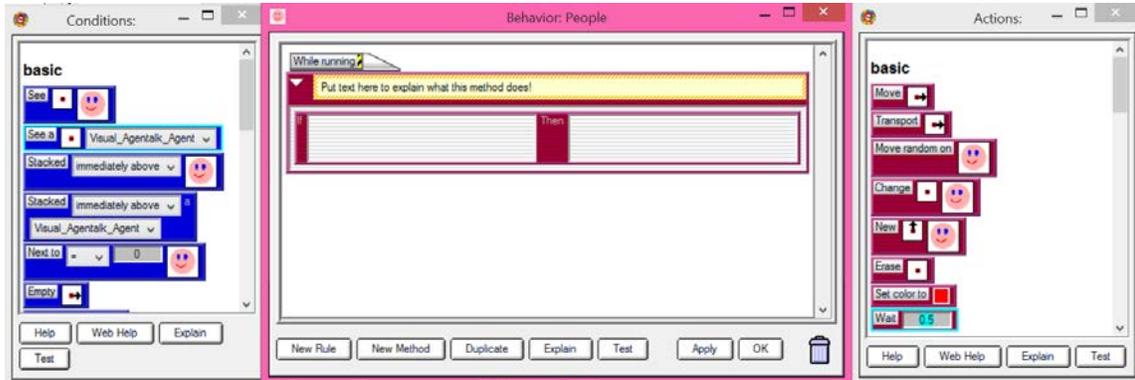
Contagion (Continued)

<p>Step 10</p>	<p>Use the tools to place the floor on the worksheet. Then place many healthy people and one sick person on the floor.</p> <p>Pencil: places agents one at a time (Works well for people)</p> <p>Filled in Rectangle: Places agents in an array. (Works well for the floor)</p>	<div data-bbox="544 210 673 357" style="border: 1px solid black; padding: 5px; background-color: #fff9c4; display: inline-block;"> <p>Helpful Tips</p> </div> <p>It is important that you do not draw over the agents. Agents can stack on top of one another which is not visible from a 2-dimensional perspective. Take care to create a single layer of agents.</p>  <p>The screenshot shows a software window titled 'Worksheet: Contagion'. The main area is a bright cyan rectangle representing the floor. On this floor, there are approximately 12 red smiley face icons representing healthy agents and one green smiley face icon representing a sick agent. The icons are scattered across the floor. At the bottom of the window, there is a control panel with a play button, a slider between 'Slow' and 'Fast', and 'Reset' and 'Clear' buttons.</p>
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This is a good time to save the worksheet

Part 3: Program the Agents

*Click on the agent and then click **EDIT BEHAVIOR** to add behaviors to that agent*



Three boxes will appear: conditions, behaviors, and actions. It helps to arrange your page so they stay in this order. You can click on the blue or red coloring to drag in conditions and actions. If you make a mistake, drag it to the trash.

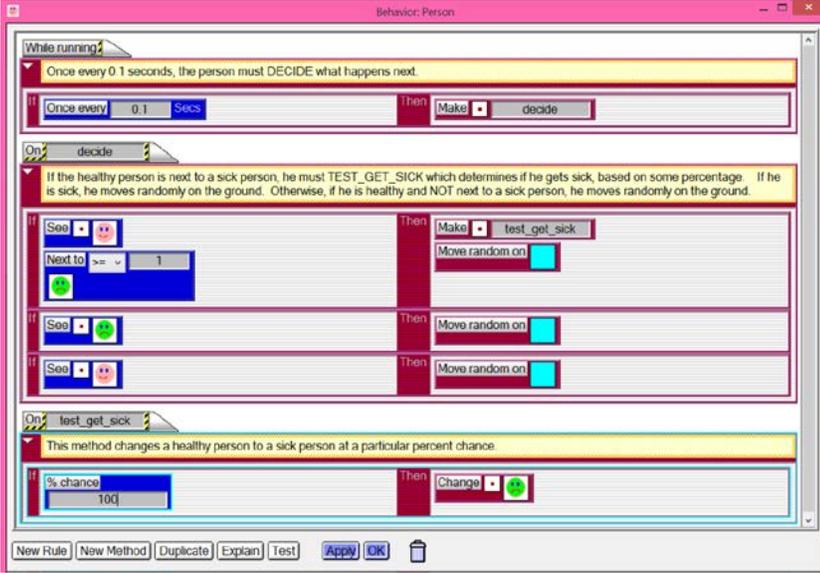
<p>Step 1</p>	<p>Create behavior for the person</p>		<p>Click on the person agent. Then, click EDIT BEHAVIOR.</p>
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Now it's time to program...

Every 0.1 seconds DECIDE what happens next

If you are healthy and next to a sick person, determine if you get ill, using the method TEST_GET_SICK.

1. Create a rule so that when a healthy person is next to a sick person, he **SOMETIMES** gets sick. Consider what percent of the time that should be.
 - If you are healthy and not next to a sick person, you should just move randomly on the ground.
 - If you are sick, you should move randomly on the ground.

<p>Step 2:</p>	<p>Create rules:</p> <p>Healthy people become sick when they are next to sick people (at some percent of the time!)</p> <p>Click NEW RULE:</p> <p>If they are NOT next to the sick person, the second rule is true.</p>	 <p>Click on EXPLAIN to understand the rule. It says:</p> <p>IF...</p> <p>I see that I am healthy AND I am next to at least One sick person THEN check to see if I get sick</p> <p>When I check to see if I get sick, my rule says, IF the % chance is 100% THEN change me to a sick person.</p> <p>Talk with the person next to you – is 100% logical? If not, change it to a more reasonable number.</p> <p>The other rules (which only activates when the healthy person is NOT next to a sick person) tell the people (both sick and healthy) to move randomly on the floor.</p>
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Once your simulation is programmed, run it to see what happens. Work with a partner to answer these questions:

- What happens when the percent is changed to zero? What would that mean in real life?
- What happens when the percent is changed to 100. What would that mean in real life?
- What percent is realistic for this simulation if it were the common cold? What percent is realistic for this simulation if it were Ebola?
- What causes the simulation to stop? Why?

Student Handout 2:

Part 2 – Getting better!

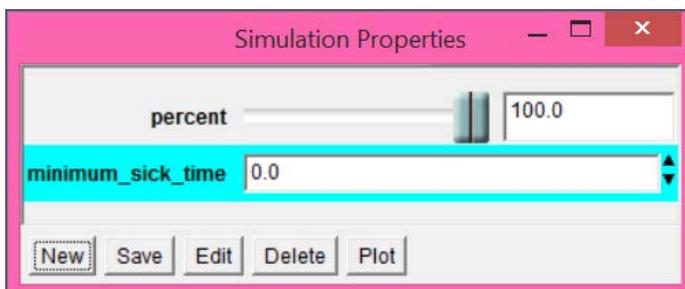
As you discussed with your class, you don't stay sick forever – even though you might feel miserable with a cold, you will get better, generally in a week or so. We are going to change the simulation to reflect that people do get better, and it takes 7 – 10 days.

We are going to designate that all sick people will take at least 7 days to get better (using a simulation property `MINIMUM_SICK_TIME`), and some might take a bit longer (as many as 10 days) using a randomly generated value of the variable (`EXTRA_SICK_TIME`). We will use a variable called as `SICK_CLOCK` to count down how long someone has been sick. We will use the `TEST_RECOVERED` method to check how many days are left of being sick.

Confused? Don't be – we'll take this step by step.

First, let's create some variables. Open the simulation properties (Tools>>Simulation Properties)

Click on **NEW**, and title it `minimum_sick_time`. Click **OK**. You should now see this:



Set this to 7 (to represent the 7 days) and click on **SAVE**.

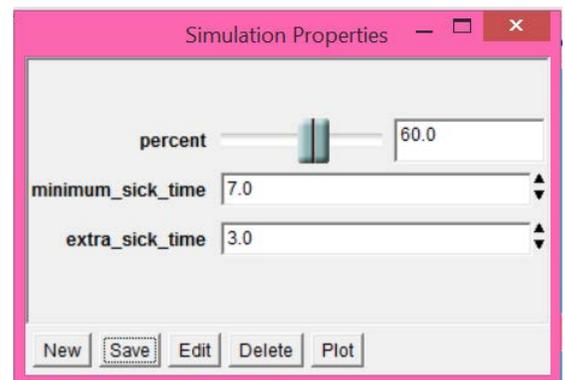
Now, repeat this process and create the variable `extra_sick_time`. Set it to 3 (to represent the three extra days someone could be sick) and click **SAVE**.

Your simulation properties should now look like this:

To do the remaining programming, we will do it in steps...

Step 1: When a person gets sick, start the sick clock countdown

Step 2: If I am sick, check to see if I'm still sick each 'day'



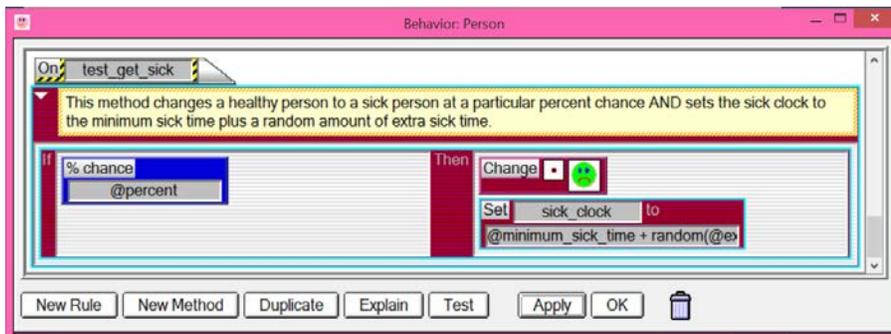
Contagion (Continued)

Step 3: Check to see if the sick clock is down to zero – if it is, change me back to a healthy person. (If not, count down another day - I stay sick).

Step 4: Create a sick clock starting time for your first sick person (already on your worksheet).

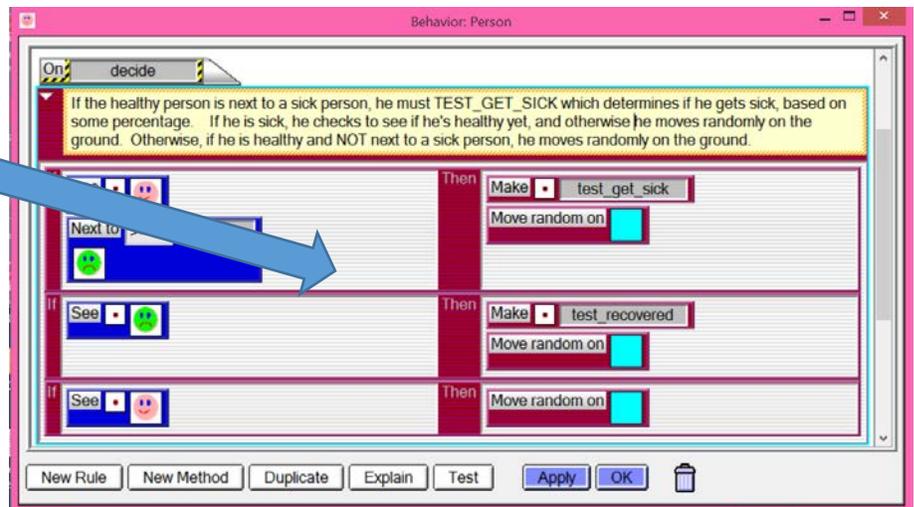
Let's get started!

Step 1: When I become sick, set the sick_clock to the minimum_sick_time plus a random amount of extra_sick_time.



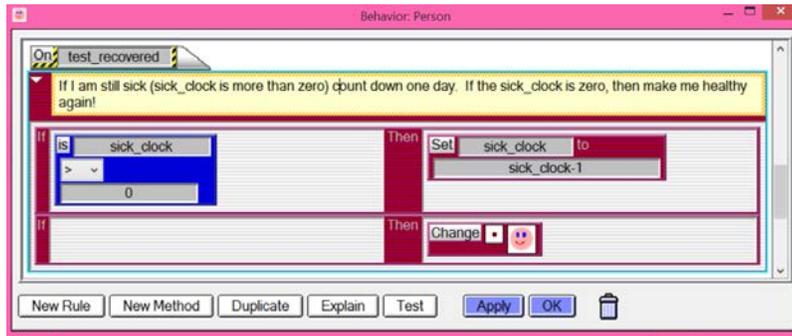
Set sick_clock to @minimum_sick_time + random(@extra_sick_time)

Step 2: Once I'm sick, check to see if I am still sick.



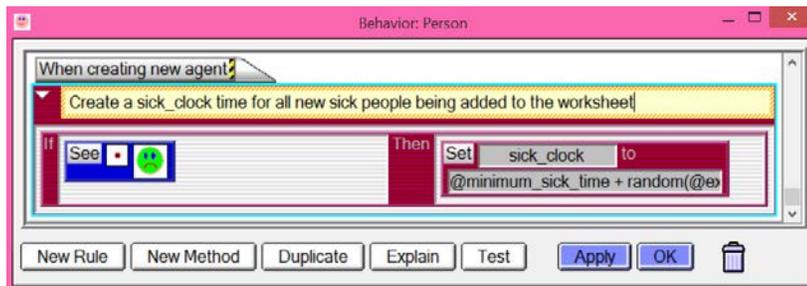
Contagion (Continued)

Step 3: Add the method `test_recovered` to count down the sick clock and then change me back to healthy if the clock is zero.

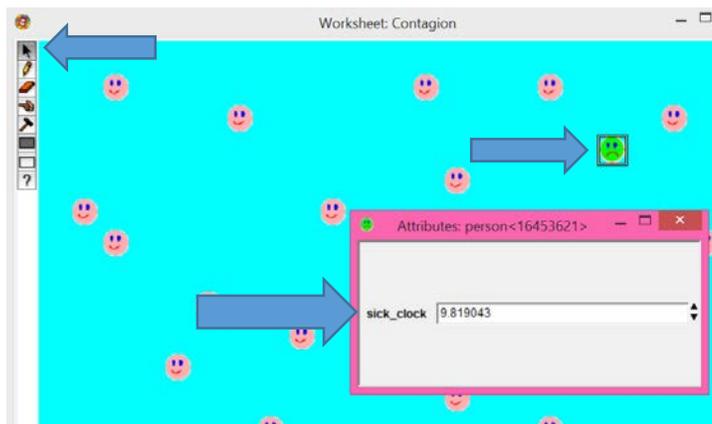


Step 4: Before you test this, you need to set the sick clock for your very first sick person. To do this, add this code to your person:

If I am sick, Then, **Set sick_clock to** `@minimum_sick_time + random(@extra_sick_time`



Delete your original sick person from your worksheet and add a new sick person. **SAVE YOUR WORKSHEET.** You can check to see the sick_clock value for your sick person by clicking on the arrow on the worksheet, and then clicking on the sick person (highlighting him). Then select (Tools>>Agent Attributes). It should show the sick clock for your agent.

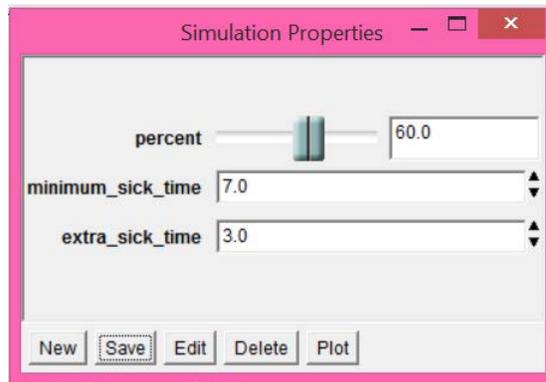


Contagion (Continued)

Run your simulation several times to see what happens. (Remember that it will operate as fast as your computer processor – you can use the slider at the bottom of the worksheet to slow it down, or you can add a ‘once every’ command to the first line of your code to slow it down.)

What happens in your simulation? Is it what you expected?

Open the simulation properties (Tools>>Simulation Properties). Try changing the variables to determine how they affect the simulation.



- What happens if you make the percent who get sick higher? Lower?
- What happens if the cold lasts longer?
- What happens if some people already have a weakened immune system and stay sick longer?
- What happens if there are more sick people in the simulation?
- What happens if there are more healthy people in the simulation?
- In what ways does this simulation reflect the real world? In what ways does the simulation not reflect what really happens?

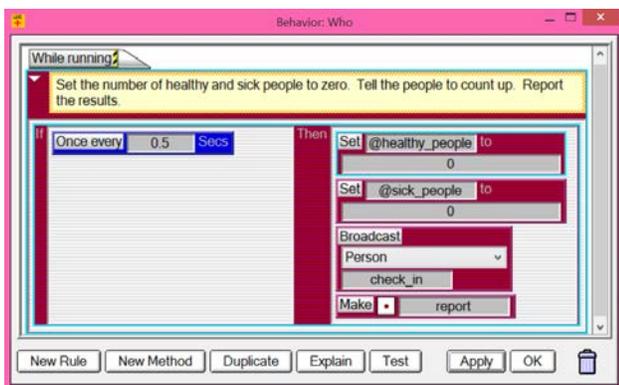
Student Handout 3:

Part 3 – Who’s sick – Who’s not? Gathering and Plotting the data

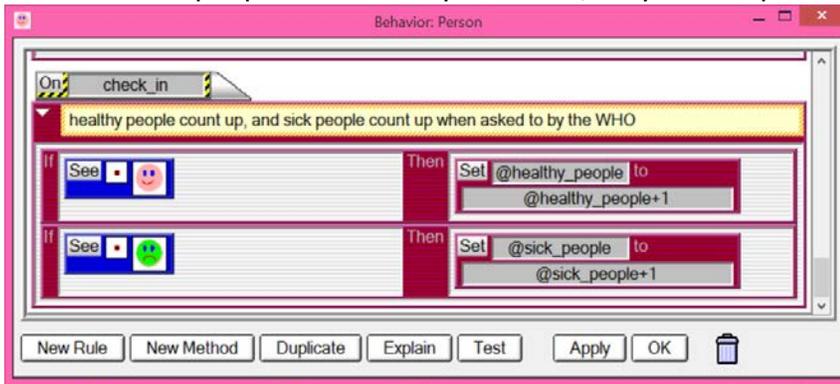
In this next lesson, you will learn to use simulation properties to track the number of healthy and sick people in their ‘world’ and then how to plot those properties.

Because epidemics can affect huge numbers of people all over the world, the United Nations created the World Health Organization to provide leadership on global health issues. This organization is responsible for the eradication of smallpox, and is working on eradicating several communicable diseases including HIV, malaria and tuberculosis. This organization is also very involved in trying to mitigate the current Ebola outbreaks. As part of its responsibilities, this organization surveys huge numbers of people every year to determine who has what illness. In our simulation, the WHO will become the controller (like the controller in Journey or PacMan) and will survey all of the people on the worksheet to determine who is healthy and who is sick.

Step 1: The WHO will set the number of healthy people and sick people to zero. The WHO will then survey the people by broadcasting a request for them to count themselves.

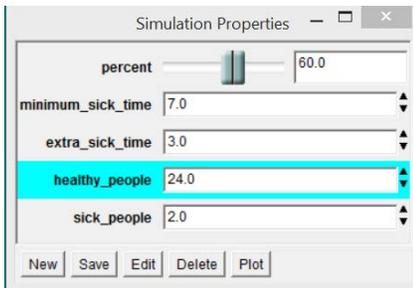


When the sick people are called by the WHO, they count up.

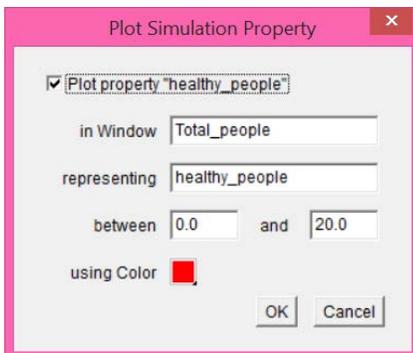


To watch the data, click on Tools>>Simulation properties. You will see the numbers of sick and healthy people change.

To plot the data, use the option to plot them in the Simulation Properties box.

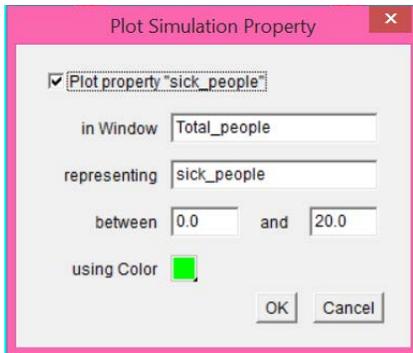


Highlight the property you wish to plot. Click on plot.



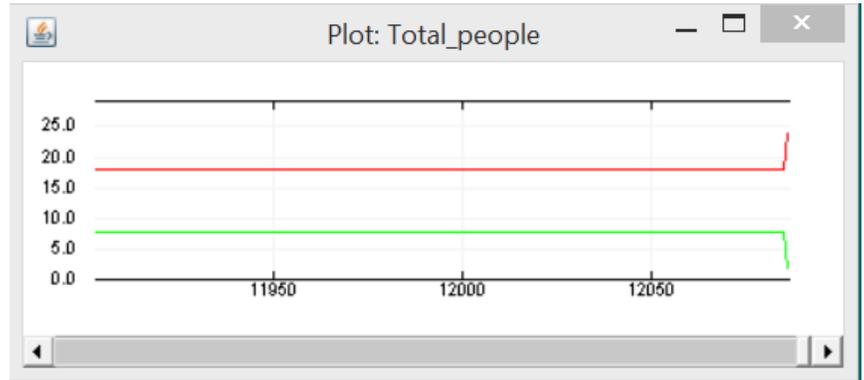
Create a window name (I chose Total_people) and change the min/max values to reasonable values for your worksheet.

Contagion (Continued)



Do the same for the second variable. Again, be sure to rename the window to match the first same so that they are plotted on the same graph. Change the min/max values to reasonable values for your worksheet. Change the color to a different color.

Run the simulation. Hint: the plot is sometimes hiding behind the worksheet. You may have to do some rearranging.



Student Handout:

Challenge 1.0: WHO Reporting

Before you start this challenge:

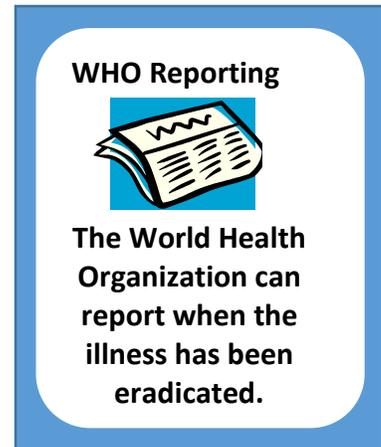
- You must have a complete basic Contagion simulation that enables people to get better after a certain amount of time.
- You have a World Health Organization (WHO) that polls people, asking them to count who is sick and who is healthy.

Design Challenge:

For serious diseases (like Ebola), the World Health organization is responsible for tracking the illness and reporting on the spread of that illness.

Add a method to notify the player when the simulation must end, either because:

- There are no sick people left
- There are no healthy people left.



Student Handout:

Challenge 2.0: Deaths

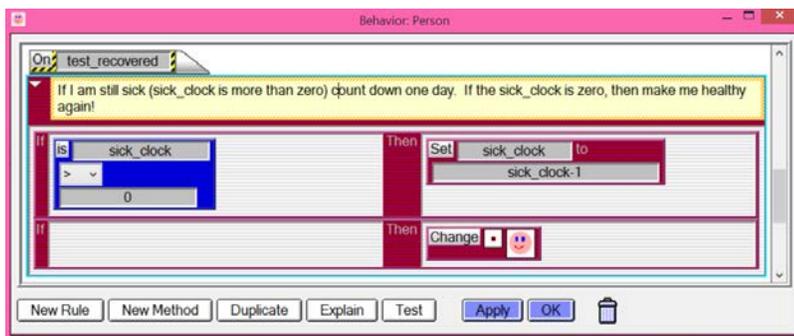
Before you start this challenge:

You must have a complete basic Contagion simulation that enables people to get better after a certain amount of time.

Design Challenge:

For serious diseases (like Ebola), not everyone gets better. Some people will die. Change your game to have some small percentage of people die. Be sure your percentage of people who die can be changed using a slider.

Hint, to do this, change the second rule in this code:



At the end of the sick time...EITHER, I get better, OR I die. So, create a method that checks to see if I live...At some percent of mortality, I change to a dead person, otherwise I change to a healthy person.

You should be seeing some new actions and a new depiction.

Something to consider...do dead people continue to move randomly?

Be sure to plot the deaths.

Student Handout:

Challenge 3.0: Quarantine

Before you start this challenge:

You must have a complete basic Contagion simulation that enables people to get better after a certain amount of time.

Design Challenge:

For serious diseases (like Ebola), not everyone gets better. To prevent a spread of the disease (so that it doesn't become an epidemic), sometimes people are quarantined.

Create a hospital area where sick people go. They remain in quarantine until they are healthy.

Again, you should see a new agent and new actions.

Hint: You will need to use diffusion and hill climbing to get the sick people to search out the quarantine area. Look back at Journey if you need a reminder of how to do that coding.

Questions to answer once you are done...

- Does a quarantine area prevent diseases from spreading?
- How long must someone remain quarantined for it to be effective?
- When is quarantining necessary? Should we quarantine people with the flu? The common cold? Cancer?

