StarLogo Nova Activity: Epidemic Model

You will create an epidemic model that simulates the spread of a disease through a population. The key points to the model are:

1. Turtle agents with a red color will have the disease, and healthy agents will be yellow.
2. Turtle agents will catch the disease by colliding with an agent who is already sick.
3. A sick individual will have a chance to recover at every step.

To construct this model, you will need to:

1. Create turtle agents in the world.
2. Make some of those turtle agents sick.
3. Make the turtle agents move.
4. Make the disease spread via collision.
5. Make a line graph that displays the count of sick and healthy turtle agents.
6. Make the turtle agents recover.
7. Expand the model and make it your own!

Prerequisites:

- Navigate to profile
- Create project
- Rename project
- Create turtle agents
- Give each agent different traits (color/shape)
- Take Camera
- Switch between Pages
- Resetting the simulation: deleting old turtle agents before creating new ones
- Scatter turtle agents

Learning Objectives:

- Describe how to use the "random___ " block to assign a trait to a portion of the agent populations and in movement
- Form conditional expressions using comparison operators and "If___" blocks
- Give an example of a trait dependent collision and explain how these are programmed
- Explain how the model accurately simulates an epidemic model
- Construct a line graph of healthy and infected turtle agents

New Terms:

- Random

New Blocks:

- random___

Read the description of each part and see if you can figure out how to put the blocks together. Then check your solution. Test your program often to make sure that each chunk of code you add works before moving on to the next part.

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Part 1: Create a population of agents

Take a look at these skill cards for more information:
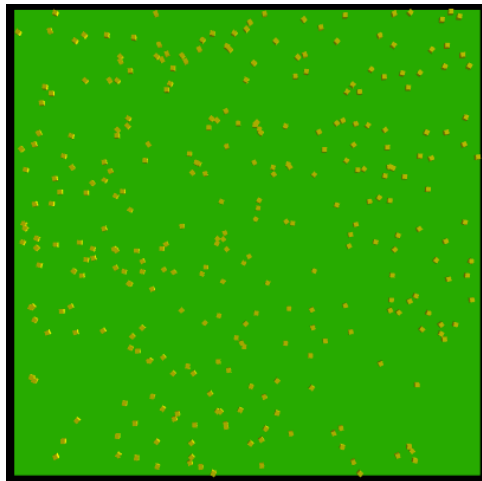- Agent Traits (2)
- Custom Shapes (16) (Optional)

Steps
- Create a new blank project and rename the project to "Epidemic (Your username)"
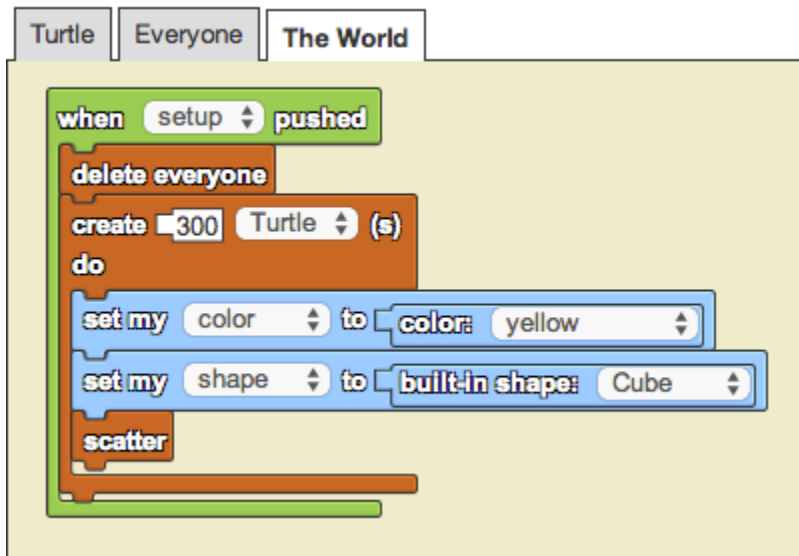- On The World page, make 300 yellow Turtle agents appear scattered in SpaceLand when "setup" is pushed.

More info: The agents' default shape is a cube. You are welcome to change this to something else.

Check your progress
- Click the "Run Code" and "setup" buttons

- You should see 300 yellow Turtle agents scattered around SpaceLand.

Solution

Turtle | Everyone | **The World**

```
when  setup ▼  pushed
  delete everyone
  create ▢300  Turtle ▼  (s)
  do
    set my  color ▼  to  color:  yellow ▼
    set my  shape ▼  to  built-in shape:  Cube ▼
    scatter
```

Part 2: Make some of those agents sick

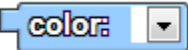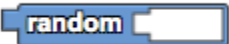## Take a look at these skill cards for more information:
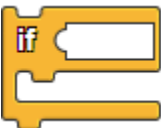
- Agent Traits(2)
- Chance (21)

Steps

- On The World page, implement an "infection" of a random 10% of all the turtle agents at the start.
- Indicate "infection" by coloring the turtle agents red.

More info: Think about **who** should be doing this test and changing its color to red. This will help you figure out **where** to put this chunk of code. Talk with a facilitator if you need help thinking through this part.

Blocks you might need:

Block	Drawer	What it means for the agent to do this:
"if ___" if	Logic	Test for something. If true, then the agent follows the commands in the hook.
"___ <= ___"	Logic	Determines if the first input is less than or equal to the second input and returns true or false.
"set my ___ to ___" set my ___ to ___	Traits	Sets the agent's trait to some value. The trait is chosen from the drop down menu and includes color, shape, size, etc.
"color: ___" color: ▾	Traits	Represents a specific color or a color at random chosen from the drop down menu.
"random ___" random	Math	For positive numbers, random returns an integer between 0 and (the specified number - 1). For negative numbers random returns an integer between -1 and the number specified. Generates a new random number each time.

Check your progress

- Click the "Run Code" and "setup" buttons
- About 10% of the turtles should be red.
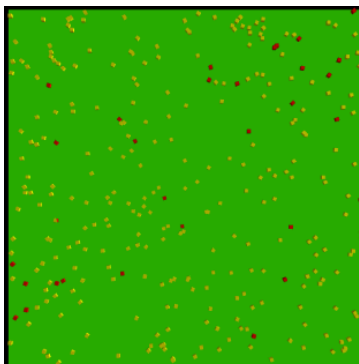
Solution
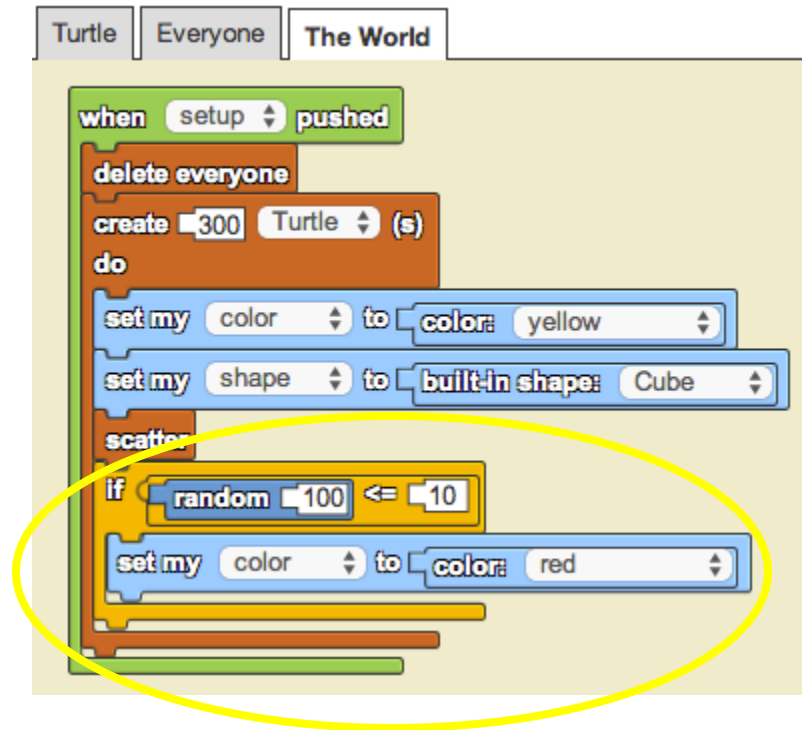
Note that this "if" block is INSIDE the "create____ do" block. This means that each of the newly created 300 Turtles is choosing a random number between 0 and 99, and checking if it's less than or equal to 10. If true, then the turtle agent sets its color to red.
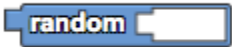
Part 3: Make the agents move

Take a look at this skill card for more information:

- Chance (21)

Steps

- On Turtle page, make the turtle agents move forward with a little randomness left/right, so they do not move in exactly a straight line, while forever is toggled on.
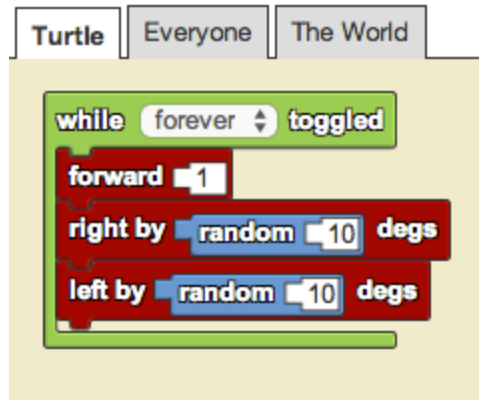
Blocks you might need:

Block	Drawer	What it means for the agent to do this:
"while ___ toggled" while [▾] toggled	Interface	Executes commands (in a forever loop) when the toggle button widget is turned on. When the toggle button widget is turned off, the commands in this block don't run. Widgets can be created using the *Edit Widgets* feature.
"if ___" if	Logic	Test for something. If true, then the agent follows the commands in the hook.
"left by ___ degs" left by [ ] degs	Movement	Turns left with a set number of degrees during each tick.
"right by ___ degs" right by [ ] degs	Movement	Turns right with a set number of degrees during each tick
"random ___" random [ ]	Math	For positive numbers, random returns an integer between 0 and (the specified number - 1). For negative numbers random returns an integer between -1 and the number specified. Generates a new random number each time.

Check your progress

- Click the "Run Code", "setup" and "forever" buttons
- Turtles should move in roughly a straight line.

Solution

Part 4: Make the disease spread via collision

Take a look at these skill cards for more information:
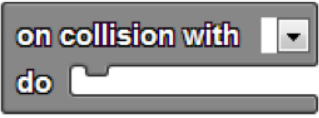
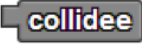- Collision (19)
- Agent Traits (2)

Steps

- On Turtle tab, make healthy (yellow) turtle agents get infected (turn red) when they collide with red turtle agents.

More info: Use an "If" block to check if the color of the collidee is red. If so, make the turtle agent set its own color to red as well.

Check your progress

- Click the "Run Code", "setup" and "forever" buttons
- Yellow turtles should turn red when they bump into red turtles.

Block	Drawer	What it means for the agent to do this:
"on collision with___do___"	Detection	Tells the "owner" of the block what to do when it bumps into an agent of the selected breed. The "owner" is an agent of the breed whose page is where this collision block is put.
"collidee"	Detection	Refers to the agent currently colliding with the "owner" of the block. (Only works inside an **on collision with** block)
"if___"	Logic	Test for something. If true, then the agent follows the commands attached to the hook.
"___=___"	Logic	Determines whether the two inputs are equivalent and returns true or false

Solution
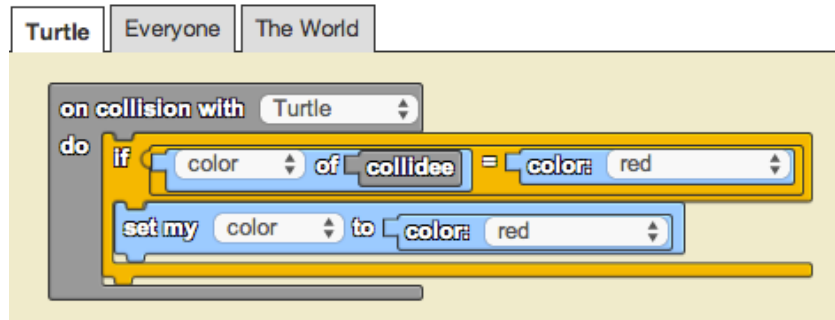
## Part 5: Make a line graph that displays the #s of sick and healthy agents.
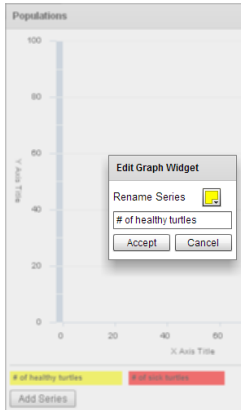
Click Edit Widgets to create a line graph widget called Populations. Double click on the Series 1 title to rename it to "# of healthy turtles". Add a new series to count the number of sick turtle agents. You can click the color square when renaming each series to match the colors of the turtle agents (red = sick, yellow = healthy). Click Edit Widgets again to exit the editor mode.

Tell the World to continually (in a "while ___ toggled" block) add the count of healthy turtles and sick turtles to the Populations graph (y-axis) over time (x-axis). You will also need to reset the graph and set the clock to 0 in the "World's" setup script.

Block	Drawer	What it means for the agent to do this:
"while ___ toggled"	Interface	Executes commands (in a forever loop) when the toggle button widget is turned on. When the toggle button widget is turned off, the commands in this block don't run. Widgets can be created using the *Edit Widgets* feature.
" Add data to line graph ___ for ___ x-axis: ___ y-axis: ___"	Interface	Adds data that's made up of pairs of x-coordinates and y-coordinates.
"count___ within ___steps with ___=___"	Detection	Counts the number of agents of a specific breed in a given radius with a specific trait. Use 200 steps to cover the entire terrain.
"color: ___"	Traits	Represents a specific color or a color at random chosen from the drop down menu.
"clock"	Environment	Returns the value of the clock, measured in "ticks". This value increments by 1 every time the code runs, which is 5x per second at normal speed.
"set clock to ___"	Environment	Sets the value of clock to some number. Typically, when you reset the clock, you want to start it at 0.
"clear line graph ____"	Interface	Removes the existing data on the graph.

Check your progress

- Click the Save, Run Code, Setup and Forever buttons
- You should see two lines being graphed on the graph.
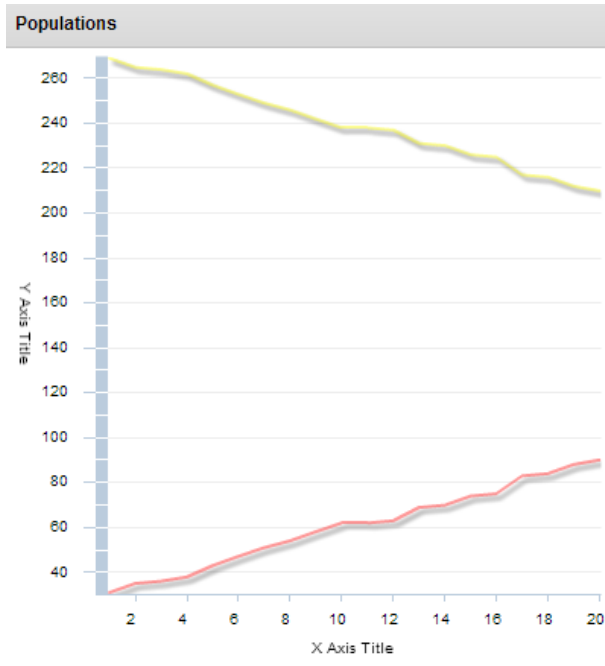
Solution

Part 6: Make the agents recover

Take a look at this skill card for more information:

- Chance (21)

Steps

- On the Turtle page, in the "while ___ toggled**" block, program each sick (red) turtle agent to have a certain probability to recover in each iteration of the "forever" block.

More info: Remember that if a turtle recovers, it should turn yellow. Note that this means that a recovered turtle agents can get sick again.

Check your progress

- Click the "Run Code", "setup" and "forever" buttons
- Periodically, red turtle agents should be turning yellow.
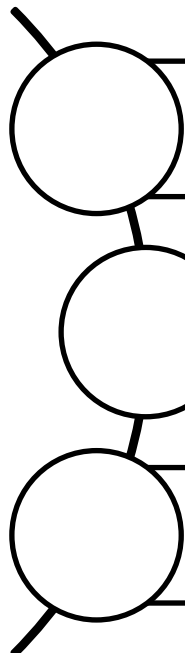- This should also affect your graph.

Solution
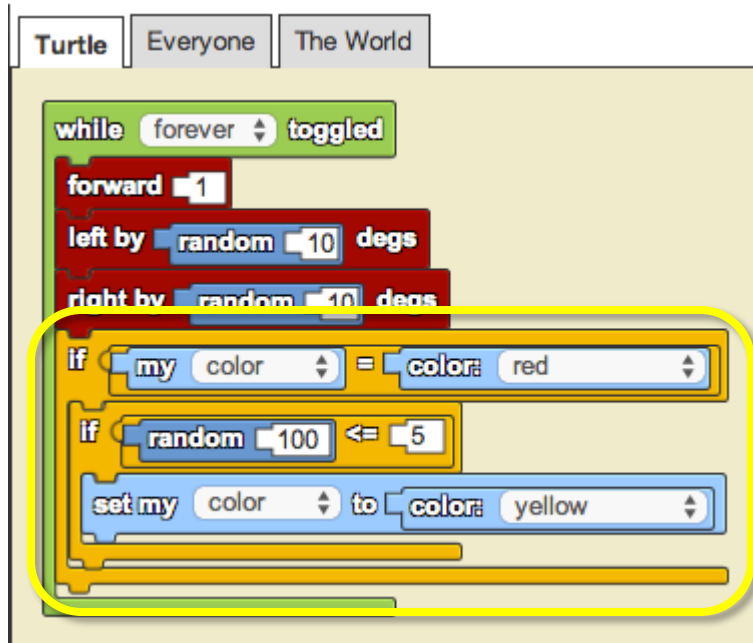
Part 7: Exit Ticket

The purpose of the exit ticket is to check your understanding and review what you've learned during this activity. There are two parts and you can do either one or both. One part consists of several programming tasks. The other part consists of a few concept questions, which you discuss with a partner.

Programming tasks

- You may want to REMIX (make a copy of) your project before you attempt these tasks so that you are working from another copy of the project.
- Complete each task. Try each task on your own first. You may ask clarifying questions or for hints. Although it should be self-evident if you're able to complete these tasks, feel free to ask a facilitator to check your solutions.

When finished with the tasks, click Save.

Infect 30% of the Turtle agents at the beginning

Create 10 white "Antibiotic Agents" (new breed) that heal sick Turtle agents when they collide.

Program sick turtles to move slower or not move at all. Does this make any difference in slowing the spread of the disease?
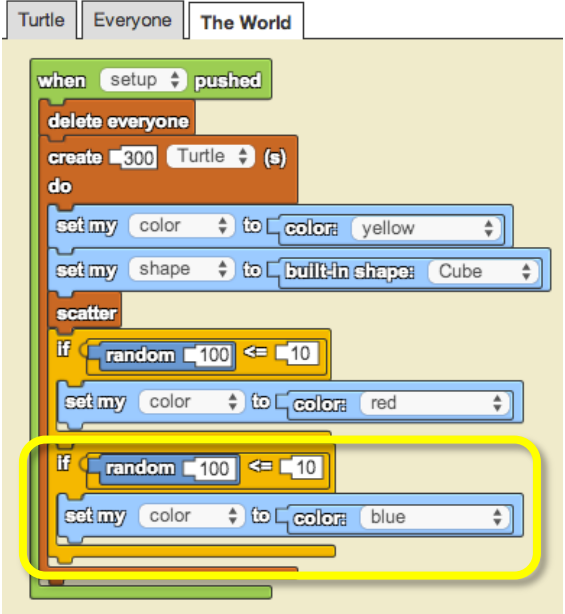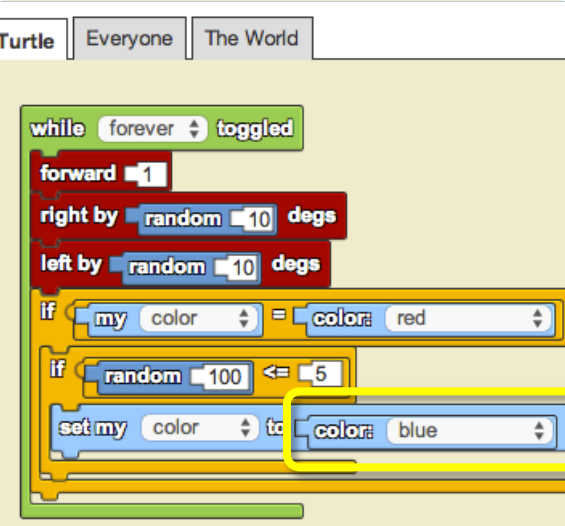
Epidemic Concept Questions

Concept Question #1

With your partner, look at the following code and answer the questions below.
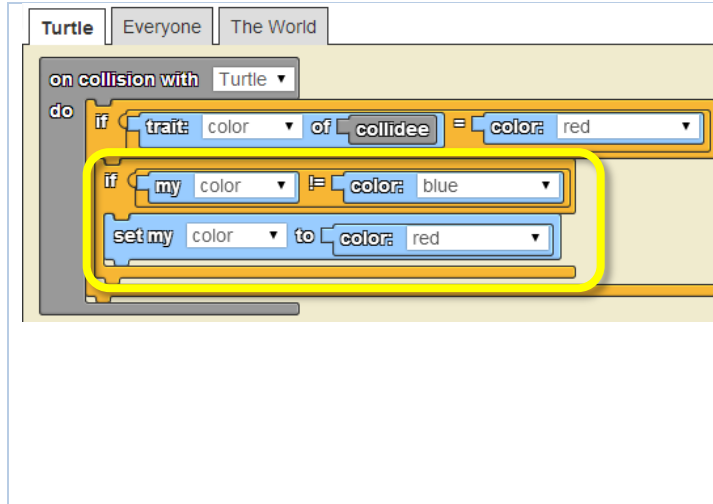
a) What happens when you put the "random" block in your code?
b) Where else could you use the "random" block in projects you've already programmed?
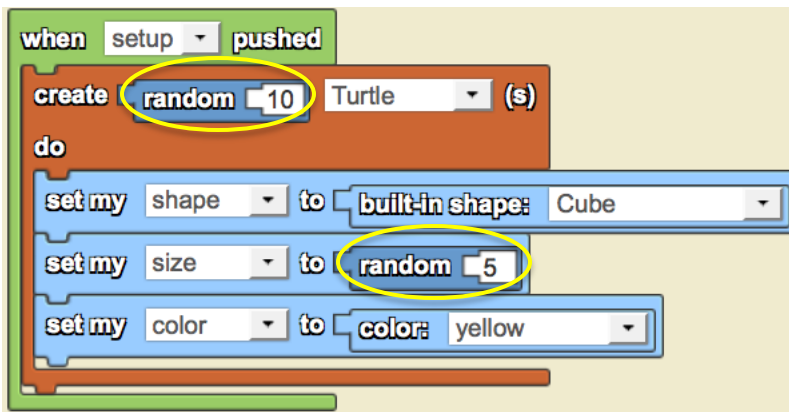
Part 8: Extension Plus - Create Immune Turtles

In this section you will create turtles that are immune (or become immune) to the virus and therefore will not get sick (again).

	1. Create immune turtles • Like you did in part 2 for the 10% infected turtles, set 10% of the turtles to be immune when you press setup. • *These immune turtles should be blue.*
	2. Adjust the recovery code so that turtles that have recovered become immune to the disease. • Change the color you set the recovered turtles in part 6 to blue instead of yellow.

Turtle Everyone The World on collision with Turtle ▾ do if (trait color ▾ of collidee = color red ▾) if (my color ▾ != color blue ▾) set my color ▾ to color red ▾	3. Adjust the collision code accordingly so the immune turtles no longer get sick. You will do this by ONLY changing the turtle's color to red IF "my color NOT EQUAL (!=) blue". - In the turtle page, you will need to include an "If___" block inside the "If___" block you already have. - With this new "If___" block, check if the color of the turtle agent is NOT EQUAL (!=) blue. - Inside the "if___" block you just placed, set the color of the turtle agent to red.

Check your progress

- Click the "Run Code", "setup" and "forever" buttons
- At setup, some turtles should be blue.
- Blue turtles should stay blue when they collide with a red turtle
- Red turtles that recover should turn blue.

Part 9: Open-ended Extensions

Come with up a question to investigate or just tinker with the existing model. Note that the suggestions in the list below tend to progress from easier tasks to harder tasks. Some of them also require you learn to use new blocks that haven't been introduced yet. You are also welcome to come up with your own extensions and just explore/try things on your own.

Decide how much time you want to spend on these extensions. When you're ready to move on, consult the roadmap to decide which activity you want to do next.

- Change set up conditions - % immune, % infected
- Change recovery probability – e.g., how does lowering it (turtles take longer to recover) affect the spread of the disease?
- During a collision by a turtle agent with a sick turtle agent, program there to be a 50% chance that a healthy turtle agent will get sick.
- Vary the recovery probability – perhaps some percentage of the population recovers quickly while others take longer to recover.
- Vary how likely a turtle will get sick – perhaps some percentage of the population are more susceptible than others.
- Add a vaccination center (new breed) that makes turtles immune when they collide with it. Do all turtles need to be vaccinated to stop the spread of the disease?
- Add doctors (new breed) that can "cure" sick turtles. If you've already done Paintball, you can program keyboard controls to move one of the doctors and to "shoot" vaccines at turtles.
- Which factor seems to slow the spread of the disease the best?