Name:________________________________ March 20, 2014

# Algebra II: Viruses

## 1 What is it?

This program simulates what happens when a virus is introduced into the population. We start out with a population, some percent of which is vaccinated, and see how many people get sick.

## 2 How it works

The model is initialized with 1000 people, of which 10 are infected. People move randomly about the world in one of three states: healthy but susceptible to infection (green), sick and infectious (red), and healthy and immune (gray). People may die of the infection. Some of these factors are summarized below with an explanation of how each one is treated in this model.

### 2.1 Infectiousness

The **infectiousness** slider changes how likely a healthy person (green) is to catch the virus if they come into contact with a sick person (red). If set to 100%, then every person that touches a sick person becomes infected.

### 2.2 Chance of Survival

One someone catches the virus, they can either get better or they die. After 10 weeks, every sick person (red) has a chance of surviving equal to the **chance-recovery** percent. If they survive, the sick person (red) becomes immune (gray), and can't get sick again. If they don't survive, the person is deleted from the simulation, and the total population goes down.

### 2.3 Vaccinated

Of the 1000 people, we we can set **%Vaccinated** before the outbreak. If a person is vaccinated, they start off immune (gray) to getting sick.

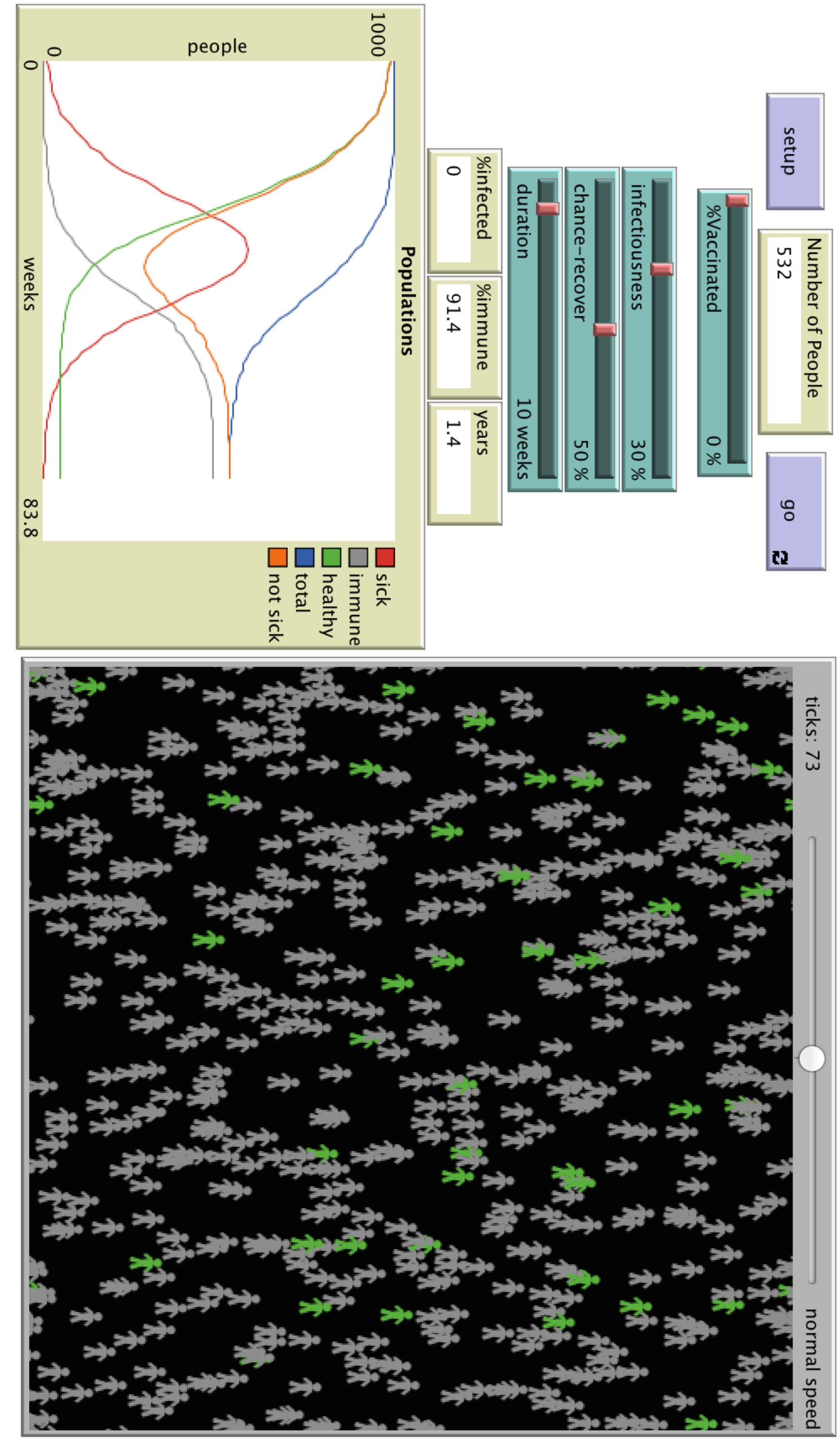


Figure 1: Screenshot of NegLogo

## 3 Composite Functions

The graph in the bottom left shows the number of sick (red), immune (gray), and healthy (green) people as a function of time. It also shows the total number of living people (blue), and the total number of people not sick (orange)

1. We call someone healthy (green) if they are not sick **AND** not immune (gray), and not sick (orange) if they are healthy (green) **OR** immune (gray). If we only know the number of healthy (green), sick (red), and immune (gray) people from the simulation on the right, how would we write down the number of people not sick?

$$N(t) =$$

2. Write down a function for the total number of people, $T(t)$, as a function of the number of sick people, $S(t)$ and the number of not sick people, $N(t)$.

$$T(t) =$$

## 4 First Scenario

Let's assume you introduce a new virus into a population with no immunity. Assume your chances of getting sick are 30% if you touch a sick person, and that the virus kills **everyone** that gets sick.

1. What values would you plug into the simulation?
   - infectiousness =
   - chance-recovery =
   - %Vaccinated =

2. Now plug these numbers into NetLogo. What happens? How many people survive the disease?

3. At what time (in weeks) are the most number of people sick?

4. Use the mouse to find the number of sick, not sick, and total people at the time from question 3. Do the numbers add up correctly?

## 5 Second Scenario

Let's do the same thin again, but now assume 40% of the population was **vaccinated** ahead of time.

1. What values would you plug into the simulation?
   - infectiousness =
   - chance-recovery =
   - %Vaccinated =
2. Plug these new numbers into NetLogo. What happens? How many people survive the disease this time?
3. Now find the number of healthy people and the number of immune people that survived. Do they add up correctly?
4. How does the number of healthy people compared to what it was in the first scenario. What does this say about how vaccines work in a population?