**Investigating Herd Immunity**

**Learning Goals:**

Investigate the effects of mass vaccination on infection rates in a population.

Evaluate using data if herd immunity is real.

**Time: 1 period**

**Explore: In groups, discuss and look up the following:**

What does immunity mean?

What are two ways a person can develop immunity to a disease?

How may you as an individual benefit if many people in your community decide get vaccinated for a disease?

What is herd immunity?

Do you think herd immunity is real?

STOP here until the class has discussed the above questions.

**Prediction:**

Hypothesize how you think the rate of infection will change if we increased the number of individuals vaccinated.

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**Experiment:**

**Part 1:**

In this investigation, you will explore how the rate of infection within a population changes if you increase the number of vaccinated persons. Access the following link to open the Starlogo Nova program entitled “Disease Study1”.

<https://www.slnova.org/SRB2019/projects/695999/>

On the left, notice two buttons, a variable slider, and three data boxes.

**Set-up** = resets parameters for new trial

**Forever** = runs / pauses the program

**Variable Slider** = Move the slider to change the % vaccinated in the starting population.

**3 Data Boxes** = These numbers will change as the program is run.

On the right, notice the “Rate of Infection” graph.

**X-axis** = Time in “ticks”

**Y-axis** = Number of Individuals

What color sphere and line color on graph represents a vaccinated person? \_\_\_\_\_\_\_\_\_\_\_\_\_

What color sphere and line color on graph represents an infected person? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

What color sphere and line color on graph represents a healthy non-vaccinated person? \_\_\_\_\_\_\_\_\_\_

Notice on the “Rate of Infection” graph there are two buttons on the title bar. The first toggles between the graph and data table. Notice the data table is missing a label in the first column. This label should be “Time in Ticks” The second button allows you to download your data.

**Procedure:**

1. Make sure to switch the data table back to the graph. Move the “Percent Vaccinated” slider to 1%.
2. Press the **Set-up** button. The data boxes and graph should reset.
3. Now press the **Forever** button to run the simulation.
4. When the number of Healthy Non-Vac individuals (in yellow) decrease to zero press the **Foreve**r button again to pause.
5. To get an infection rate you need to collect two pieces of data: You need the time it took for all the healthy non-vaccinated yellow spheres to become infected and divide that by the number of healthy non-vaccinated yellow spheres there were present in the beginning. Decide how you will display your data as a group.
6. Move the slider to test at least 10 different percents for this experiment.

**Part II:**

In this part of the investigation, you will try to determine what percent of a population must be vaccinated to provide herd immunity. That is, provide protection to those who are unable to get the vaccine because they are too old, too young, or have an immunodeficiency.

**Prediction:**

Hypothesize what percent of the population must be vaccinated to provide herd immunity.

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**Note**: This second simulation includes another variable to make it more realistic. Infected persons in this simulation do overcome the illness after a certain period of time.

Over time, the red spheres will turn blue when they become better. However, they can still infect the healthy yellow spheres while they are still red. Why do you think these red spheres would turn blue and not yellow?

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Access the following link to open the Starlogo Nova program entitled “Disease Study 2”.

<https://www.slnova.org/SRB2019/projects/696121/>

**Procedure**:

1. Move the slider to test different levels of vaccinations. Press **Set-up** then the **Forever** buttons.
2. Document the percents you test and describe the results on the population. Herd Immunity will be seen only when the infection cycle is completed (no more red spheres) leaving some yellow spheres unaffected (protected).

**Conclusion:**

Two predictions were made. Discuss each separately. Include data to support are reject your hypothesis. Discuss the reasons your data supports or rejects your prediction.