Teacher's Guide: ***The Math of the Flu***

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Thank you for considering this exercise for your class.

1. Goals. Here are the goals of this one-class learning exercise:

To show students that math can play a role in understanding how an infectious disease spreads and can be controlled.

To have the students see and use both deterministic and probabilistic models.

To learn by doing, role-playing.

There are no equations to solve in this exercise. It is fun and instructive and not heavy in math. There is an accompanying math-oriented short paper available on this web site, if you and your students want to delve more deeply into the math behind this exercise. Of course, there are entire books using rigorous mathematics that present models of infectious disease progression. In this BLOSSOMS exercise, we just touch the surface, in part to show the students that here is yet another application of interesting mathematical ideas, an application that pertains directly to their lives, and the lives of their family, loved ones and friends. A second equally important objective is to show them that there are several easily adopted behavioral changes for themselves and their family and friends that can reduce, sometimes substantially, the likelihood that they will become infected with the flu.

2. Prerequisites: There are no formal prerequisites, as students in any high school or even middle school math class could enjoy this learning video. But more advanced classes can go into the optional applied probability modeling that accompanies the module in a downloadable pdf file.

3. Class exercises: The primary exercises are class-intensive simulation games in which members of the class 'infect' each other under alternative math modeling assumptions about disease progression. These games require use of random numbers drawn from a hat or basket or similar holding device. Also there is occasional class discussion and local discussion with nearby classmates.

4. Materials needed. The required materials are modest, inexpensive and widely available almost anywhere. We just need ways to indicate visually the 'disease state' or 'wellness state' of each student, and a way to select students randomly. Here's what we suggest:

a) For each student, create 3 homemade oval hats, suggested **Green** for **Susceptible**, **Red** for **Infectious**, and **Blue** for **Recovered and Immune**. The hat is oval, fitting nicely on the head. This hat can be made of cardboard or thick paper, cut into a rectangle maybe 3 or 4 inches vertical height and enough length so that when joined by Scotch tape or staples or paper clips at the two long ends, there is sufficient dimension to fit comfortably on one's head. Each of the N students in the class will be given an integer identifying number, 1, or 2, or 3, or … *N*. That number should be written onto the hat in 3 places, so that the student's ID number can be seen from any direction. The teacher can assign the making of paper hats to students the day before the class lesson. In that case, the students may be encouraged to be original and funny yet respectful in their hat designs.

b) In a basket, box or similar container, place *N* equal-sized slips of paper or cardboard, each containing a unique integer 1, 2, 3. …, *N*, where *N* is equal to the number of students in the class. These slips of paper or cardboard could instead be plastic chips or similar small equal-dimensioned objects with each having written on it a unique one of the integers 1, 2, …, *N*.

5. Other remarks. The parameter R_0 plays a huge role in most epidemiology models. R_0 is the basic reproductive number. It is defined as *the average number of new infections caused by a newly infected person in a fully susceptible population*. In a new disease such as the novel H1N1 flu currently going around the globe, most people are susceptible at the start of the pandemic. This is how we model the population in your classroom. At the beginning, everyone is equally susceptible. But it is a simplification. But not all are equally susceptible, as there is evidence that older people may have antibodies from an earlier influenza that partially protect them from the current H1N1 virus. Thus, you their teacher, may be less likely to get the flu from any given person-to-person 'infection event' then your students are! The class exercises and the assumptions therein provide a rich background to discuss with the class simplifying assumptions and how they may be made more realistic with more sophisticated mathematical modules. The sophistication need not be represented by fancy mathematics, either deterministic or probabilistic, but by more complex rules in the simulation game. These ideas, plus the many public web sites that we list provide much food for thought and for further class discussion, even take-home projects.