# Modeling Disease Transmission - TA Version

BE SURE TO READ THIS DOCUMENT FIRST!

From experience, this activity can be pretty chaotic and a big time sink in class if you are not prepared for it.

During the activity, students will go around the room, playing the roles of susceptible, infected, and recovered individuals during a disease outbreak. In order to select which role each student will have for each of the 3 modeling rounds, there are varied initial states included on the 5 student versions of the activity worksheet. To help increase the likelihood of interesting phenomena, print these versions in the following proportions.

Version 1: 10% (rounding down where necessary)

Version 2: 10% (rounding down where necessary)

Version 3: 10% (rounding down where necessary)

Version 4: 50% (rounding up where necessary)

Version 5: 20% (rounding up where necessary)

As an example, in a class with 32 students, there should be 3 students each with Versions 1-3, 16 students with Version 4, and 7 students with Version 5. It is probably helpful to arrange the papers so that the versions are shuffled, and so that these proportions are obeyed even if the bottom few papers are not used (in the event of absences).

The general workflow for the activity is as follows. Students will simulate 7 rounds of the disease spread with the rules for the respective model. As a facilitator, you should call out each round (to ensure students don't pair up with people in a different round than them) and encourage students to move around and interact with different people / groups of people.

Once the rounds are finished, you should copy and fill in the table of counts for each round on the board. For each round, call out each symbol (0,1,R) and have students raise their hands if this was their symbol that round. This should be done relatively quickly, even if the numbers aren't perfect.

After each round, give the students a minute to discuss the accompanying questions, and then ask for volunteers for the answers. These are relatively simple questions, so don't spend too much time on this.

In class, we have discussed the SIR model for disease transmission. The goal of this activity is to simulate the spread of a disease and see these models in action.

### Model 1

To begin, we model a disease for which there is no recovery.

Rules: Read these aloud to the class and make sure everyone understands. There may be some questions or confusion.

1. Keep track of your current state, which is either 0 or 1. Your initial state is in column 0 of the chart below.
2. In each round, partner up with a different person in the class.
3. Write the product of your and your partner's states of the previous round in the box for this round.

Record the totals for the class in the chart below.

0 = V1,

1 = V2 + V3 + V4 + V5

| Round | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| 1 | | | | | | | | |

**1.** Which of the numbers represents a susceptible individual? Which represents an infected individual? How do you know?

**2.** Describe the infection rate of the disease.

### Model 2

Next, we model a disease for which there is recovery.

Additional Rules:

1. There is a new state R that represents a recovered individual.
2. When you partner up with someone else in state R, repeat the symbol you wrote in the previous round.
3. After 2 consecutive rounds of writing 0, switch to writing R, and do this for all of the remaining rounds.

0 = V2,

1 = V1 + V3 + V4 + V5

| Round | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| 1 | | | | | | | | |
| R | | | | | | | | |

**3.** According to this model, are people who recover immune to the disease? How do you know this? Give an example of a disease for which this is true.

**4.** Did the total number of individuals who got the disease change from the previous round?

### Model 3

In the final model, we consider the scenario where some individuals are initially "recovered". The same rules apply as in the previous round.

0 = V3,

1 = V1 + V2 + V5,

R = V4

Record the totals for the class in the chart below.

| Round | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| 1 | | | | | | | | |
| R | | | | | | | | |

**5.** How could it be possible for some individuals to be "recovered" from the disease without having had it?

**6.** Were any of the individuals who were initially susceptible able to last the entire activity without contracting the disease?

**7.** Assuming you were able to answer the above question in the affirmative, what is the significance of this result from a medical perspective.