ILLINOIS
Carl R. Woese Institute for Genomic Biology

Social Squares Spread Sickness

Overview:

Kids can use a few simple materials to represent how infectious disease spreads through a community, and can experiment for themselves how different factors—different rates of spread, quarantine measures, or the availability of a vaccine—can change the way diseases spread.

Learning Objectives:

- Create a model for the spread of disease through a community when there are lots of social interactions.
- Gain insight into how the type of disease, social distancing, quarantines, and vaccination can all change the way a disease spreads, and how health measures can protect vulnerable people from disease.

Activity Materials:

Many different materials could work for this activity, depending on what you have available!

- Cut up index cards, notebook paper, construction paper, or other blank paper into squares; ~40 should work well. On one side of each square, make a mark to indicate a healthy individual: a green dot, a smiley face, a check mark. On the other side, make a mark to indicate a sick individual: a red dot, a sad face, a circle. The activity will work well with these, but it takes a little extra set-up time.

  Or:

- A set of any kind of reversible game pieces: playing cards, Reversi or Othello pieces, Scrabble letters, checker pieces if one side has a distinctive mark on it—look around and be creative! If you can find something like this, it will save some work cutting up paper squares.

Parent Notes:

This activity has a lot of flexibility. It should work well for children in older elementary with a lot of help; older kids may be able to repeat the activity fairly independently, while younger children might be able to do a simplified version with just a few game pieces or paper squares, starting with as few as 4-10 pieces.

Background:

Infectious disease can be passed between people within communities in lots of different ways. Some diseases are spread through the air, or through contaminated food or water. Some are spread only by very close contact with other individuals. Some respiratory diseases, like the flu, common colds, and coronaviruses like COVID-19 are passed from person to person through more casual interactions: shaking hands, touching an object like a doorknob or a public touchscreen, or standing near an ill person who does not cover their cough or sneeze.

How do health workers decide what recommendations to make to help slow and stop the spread of a disease, especially a new disease? They collect data on how it spreads, and they use computer software to interpret those data and make predictions about what will happen next in an affected population.

You don't need specialized software or even a computer to try a simplified version of this at home! This activity will help you create a model population and watch how disease can spread through it, and what factors can speed up or slow down that spread.

Procedure:

1) Gather your pieces together. Lay them out on a surface like a table or a clean spot on the floor; wherever you feel comfortable sitting for a while. If you are using reversible game pieces, make sure they all have the same side face up; for example, if you are using playing cards, you could place them all with the back side up. This will indicate healthy individuals. If you are using paper squares, start them all with the "healthy" side up.
2) Flip one piece over to face the other way. Your initial case has been infected.
3) Close your eyes. Shuffle your pieces around to new positions; mix them up well, and then spread them out again the best you can. No peeking! To ensure a good shuffle, you can designate one person as the shuffler and another person to keep their eyes open and time a certain interval (e.g. 30 seconds) or just watch for when the pieces look sufficiently shuffled.
4) Open your eyes and find your patient zero is. Look at which other pieces are close to it. Decide a rule for how many others your patient can infect. Only pieces that touch it directly? Only one closest piece? The two closest pieces? Whatever rule you decide, keep it consistent through the rest of the experiment.
5) Based on the rule you've chosen, infect new patients and mark them as you marked patient zero.
6) Repeat step 3 and the rule from step 4 until your whole population is infected. How many rounds did it take?
7) Now that you have a baseline number for how long it takes to infect your population, you can repeat steps 2-6 as many times as you like to collect more data. Try changing one factor at a time to see if the rate of spread is increased or decreased. Just make sure to start with the same number of pieces each time, to keep your experiments comparable. Here are some things to try:
    a) Repeat your experiment several times with no changes. How similar are your results?
    b) Change your "rule" from step four so each infected patient infects more or fewer people, or infects people through different types of contact. For example, maybe your population starts washing hands and wearing "masks," and each sick individual only infects a healthy individual 50% of the time.
    c) Using numbers on your paper squares or paper numbers on top of your game pieces, keep track of which round each patient is infected. After a set number of rounds, change them from contagious to immune: for example, once they have been infected for two rounds, they can no longer infect others and they can't be reinfected themselves.
    d) Vaccinate your population! Before you start the game, mark some pieces with a circle or with a piece of paper, a piece of tape, or a sticker. These individuals can never be infected. What happens when just a few individuals are vaccinated before spread starts? 50%? 90%? For a given infection rule, how many individuals have to be vaccinate to stop the disease from reaching all unvaccinated individuals?
    e) What happens if, when patient zero is discovered, they are quarantined after one round? After two rounds? After three?
    f) What happens if all infected individuals are discovered and quarantined after one round of infection?
    g) What happens if the population is divided into subsections of different sizes and can only interact with others in their subsection?
8) Try as many variations as you like or have time (or paper) for!

During/Follow-up Questions:

- What kinds of questions can scientists answer by trying to make a model of how disease spreads?
  - *Examples: They can make predictions about how many people may be affected, how soon, and what kinds of changes might help control the spread of disease.*
- What things are important for scientists to know about a new disease to predict its spread?
  - *Examples: How does an infected individual infect others? How many others does an infected individual get sick? How long do infected individuals stay contagious?*
- What kinds of changes helped slow down the spread of disease?
  - *Examples: diseases spread more slowly if recovered patients are immune, if healthy people can be vaccinated and many healthy individuals are vaccinated before the disease starts to spread, if ill individuals are found and quarantined early, if the population is subdivided into isolated sections, if there are fewer interactions that can spread disease.*