Center for Science Outreach

Modeling and Preventing Community Spread

You have probably already heard how we can protect ourselves and others from the spread of infectious diseases using social distancing methods. Today, we are going to simulate the spread of an infectious disease, and learn about the **Basic Reproduction Number**. Hopefully, this will show how protective measures can limit the number of people who are infected.

Tracking and Fighting Infection

To measure how an infection spreads through a community we can use the **Basic Reproduction Number** (R0: pronounced R-nought). This number is the expected number of people a single sick or contagious person will spread an infection to. If R0 is larger than 1 (R0 > 1), then the infection will grow and spread through the population. The larger the R0, the more likely the infection will undergo community spread and cause an **epidemic**, or a quick and widespread occurrence of a disease. To best combat infectious diseases, it is best to use various methods to protect ourselves and to protect others. Examples are:

- Using good hygiene by washing hands for a minimum of 20 seconds, sneezing into tissues or sleeves, and cleaning commonly touched surfaces like door handles, cellphones, and faucets frequently.
- Staying at home if you have a fever of over 100 F, cannot work, or do your job comfortably.
- Getting a vaccine for an infectious disease if one is available. This protects yourself and others around you that cannot receive vaccines (Herd Immunity).
- Practice social distancing or self-quarantine for very infectious diseases.

Card Chain Activity

We are going to play a game to simulate the spread of infection with branching chains and calculate R0. You will need a standard deck of 52 playing cards (excluding jokers). You can access the instructions here to both play the game and calculate the R0 value for your infection model. Take your time.

FIND INSTRUCTIONS HERE

Share With Us

We would love to see your card chains and results from your experiment. If you are able, please share your findings with us. You can tweet pictures to the Vanderbilt Center for Science Outreach at @VanderbiltCSO (#CSO_STEM_Club). Or you can submit your findings to our online database **https://redcap.vanderbilt.edu/surveys/?s=39AE7CT8WD**

How Did You Do?

If you have the chance play the game multiple times, each time you have should have some important information about the numbers of single or branching card connections, the R0 values, and the number of people saved after flipping over Aces. Use the table below to summarize your data. Did you expect the numbers to be similar every time?

Trial#	# of Single Card Connections	# of Branching Card Connections	Calculated R0 Value	# of People Saved After Flipping Aces
1				
2				
3				
4				
5				

Discussion Questions

1. If you make your chain following the original rules (where face cards branch to 2 cards), what is the theoretical smallest number of branches you could end up with? The largest?
2. What is the probability that the first card you draw (aka the first person in the chain) will be a face card? What about an Ace? (Hint: Remember there are 52 cards total)

Future Exploration

If you would like to know more about how R0 and mathematics are used with social distancing, click here. If you would like to learn about a real case of tracking coronavirus check out this article.

Phenomenon Observation: First Fruit

Check out **this trailer** for a Nashville dance piece called First Fruit. The First Fruit performance begins with six people each covered head to toe in an individual post-it note color. As the performers jump, dance, roll, swing, dive, and hug, they lose their post-it notes to the floor or onto others. By the end of the show, post-it notes are everywhere, and each cast member is a multi-colored display of post-it note art.

Phenomenon Observation: Discussion

What could the post-it notes represent in the context of human health?

How might this play relate to the spread of a disease?