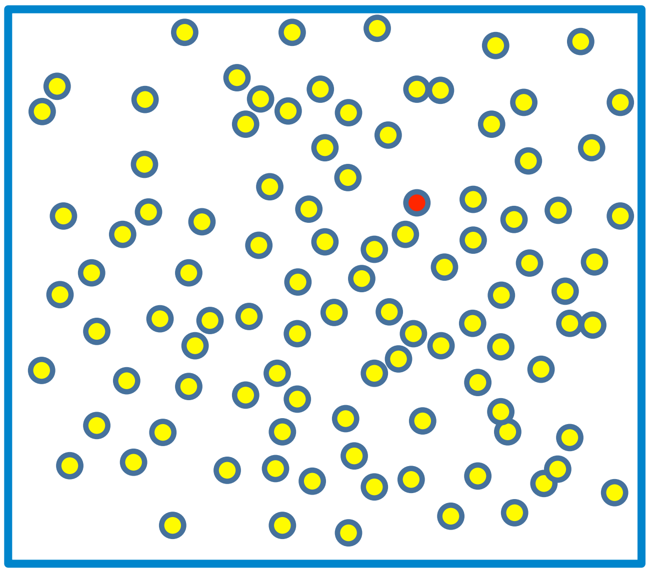
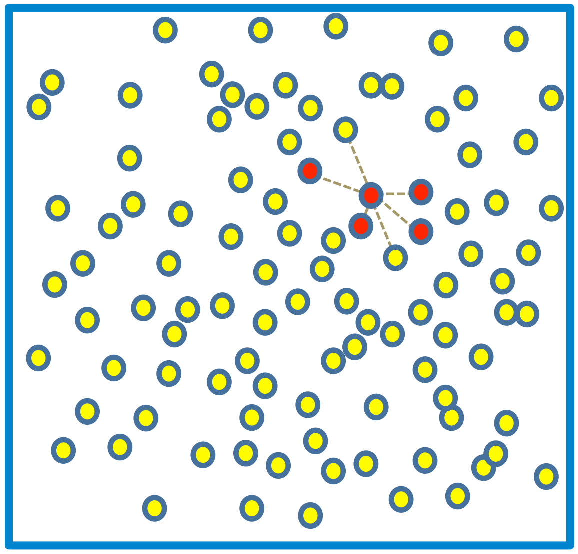
Charting Disease Spread

Back to our three colors from the Math Flu Games video: Let's think about a community of 100 people. The following figure shows a snap-shot picture of that community, each circle is a person, and total population is 100 people. Yellow dots are susceptible persons, and the red dot is the one individual who is infected. We don't know how he/she got the disease; maybe he/she was traveling and just arrived back in the community. This first person is often referred as **patient zero**. See the figure: the infected person (red) is surrounded by susceptible individuals (yellow).



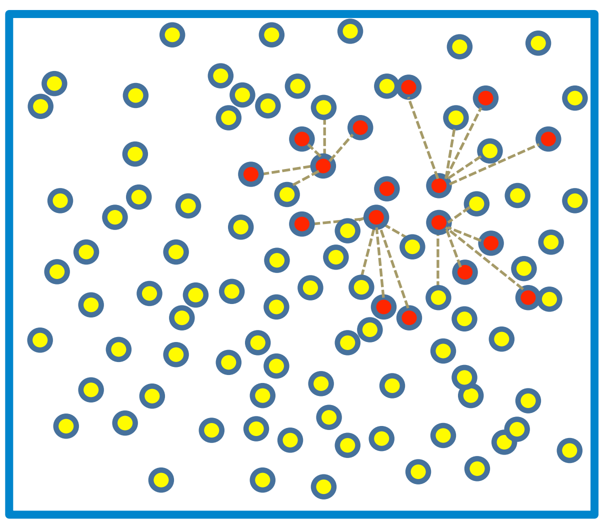
Day 1; 100 people, 99 susceptible, 1 infected.

As you see in the Figure, some people are close to each other, while others maintain their distance. Maybe the close ones are friends, families, classmates, coworkers, etc. Look at the ones close to the one infected individual. It is likely that they get infected if there is a potentially infecting interaction. Let's say the red dot has a close contact with 6 more individuals (shown by dashed-line), two siblings, two parents, and two friends. Some of them, for example 4 out of 6, will get infected in the next time period. Number of infected grows from 1 to 5.



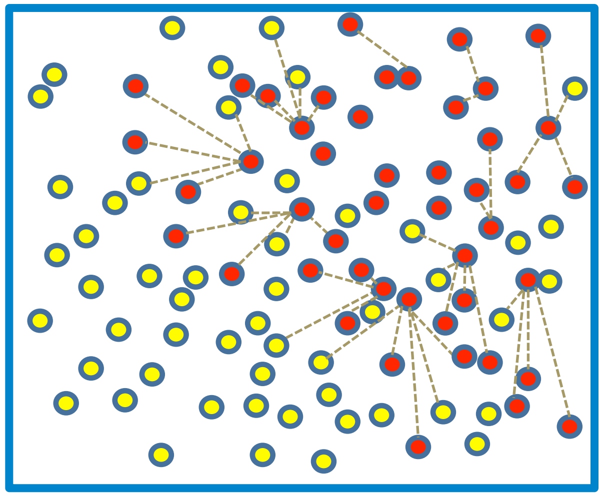
Day 2: 100 people, 95 susceptible, 5 infected.

Our friends, our siblings, even our parents (☺), have friends too! Those infected individuals may have other friends, coworkers, family members, classmates. They may also accidently get close to strangers in a mall, supermarket, or public transportation. Each of those infected may further spread the disease. The following figure is showing the same population the next day. The number of infected is now 12 more (17), which means that the population of susceptibles is declining (100-17=83).



Day 3: 100 people, 83 susceptible, 17 infected.

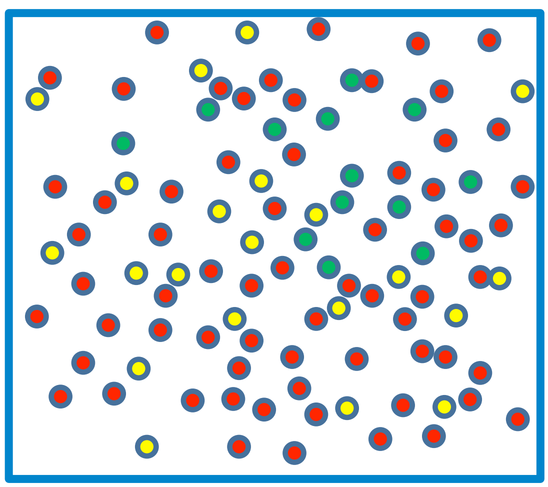
Obviously, the disease is spreading very fast, and everyday more new people are added to the red dot population. Let's check the next day, and see how many more people get infected. Each of the 12 new infected may have several more friends. We may get to much larger numbers.   Remember, patient zero only infected 4 people, but on day 3 and day 4 we had many more new cases. Think about your town: if there is only one infected individual, the chance that you accidently bump in to that person is actually very low. But if half of the population is infected, on average 1 out of 2 people that you see are infected, so there is a larger chance of becoming infected. **That's why infection can increase exponentially**



Day 4: 100 people, 53 susceptible, 47 infected.

The number in the infected population is growing. With such a fast spread of the disease, soon the great majority will be infected. But why on a daily basis, are the new cases increasing at an accelerating rate?

Is there an end to this? Yes, in multiple ways. For example: 1) As people get infected, the susceptible population (S) depletes over time; in simple words we will have fewer yellow dots. After a period, infected individuals recover (green dots). The following figure is possibly a few days after day 4, when some infected have recovered.



A few days later: 100 people, 21 susceptible, 66 infected, 13 recovered.