

S-I-R Model - tasks 1 & 3

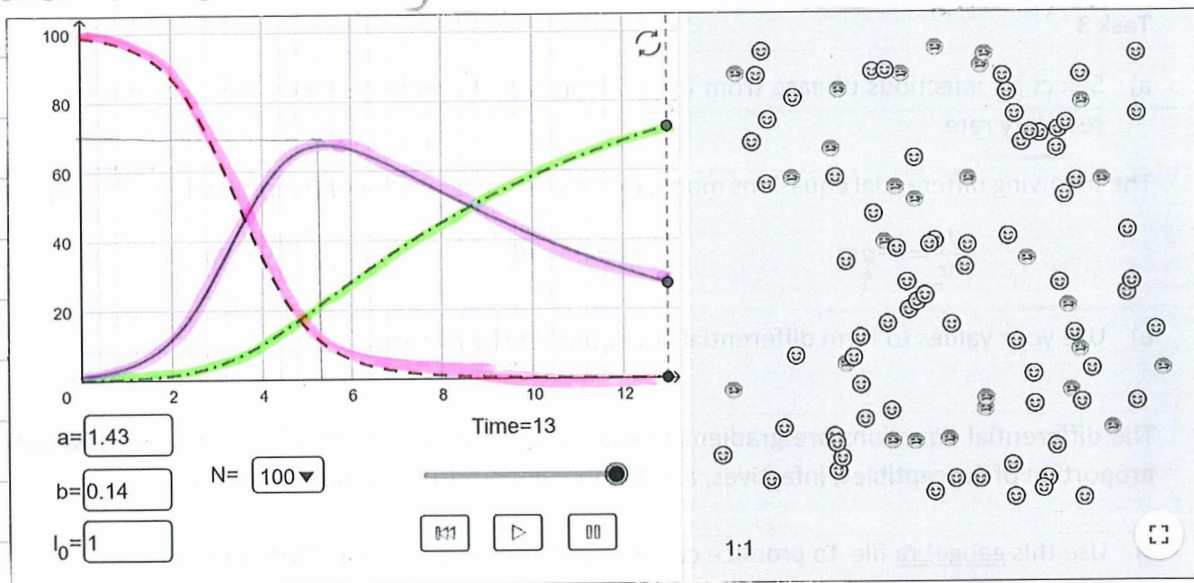
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Disease	R_0	T	a	b
Measles	12	9	1.33	0.11
Chickenpox	10	7	1.43	0.14
COVID-19	3	7	0.43	0.14
Common cold	2	10	0.20	0.10

a) Chickenpox: $a = 1.43$ and $b = 0.14$

b) $\frac{ds}{dt} = -1.43si$ $\frac{di}{dt} = 1.43si - 0.14i$ $\frac{dr}{dt} = 0.14i$

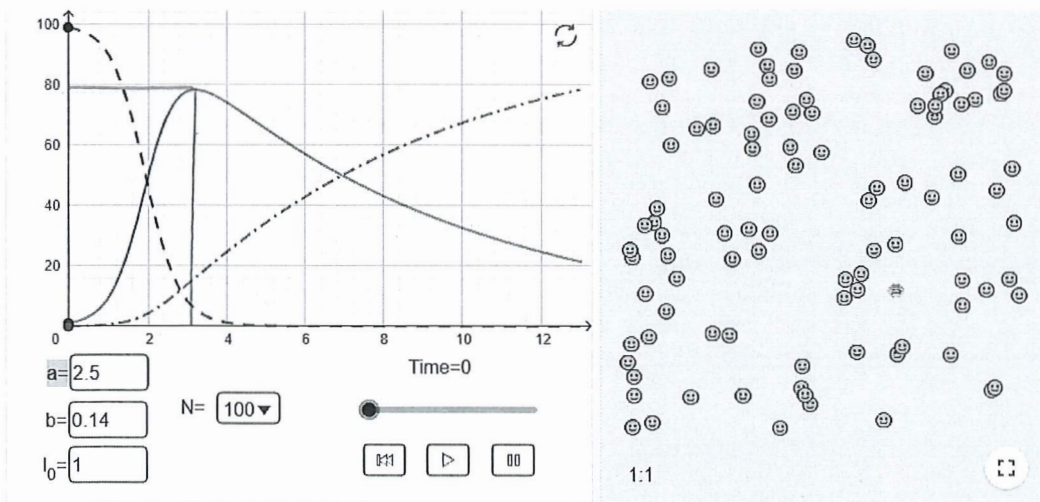
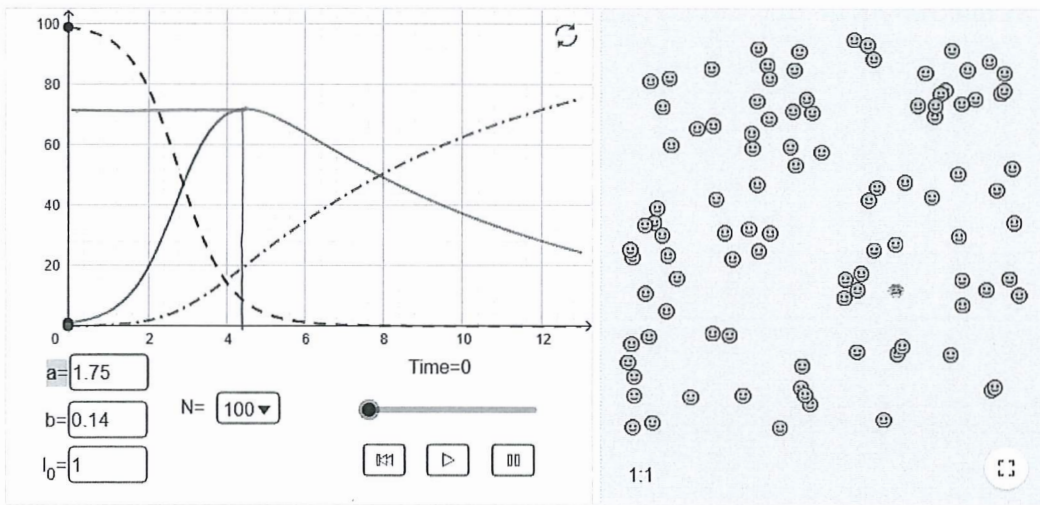
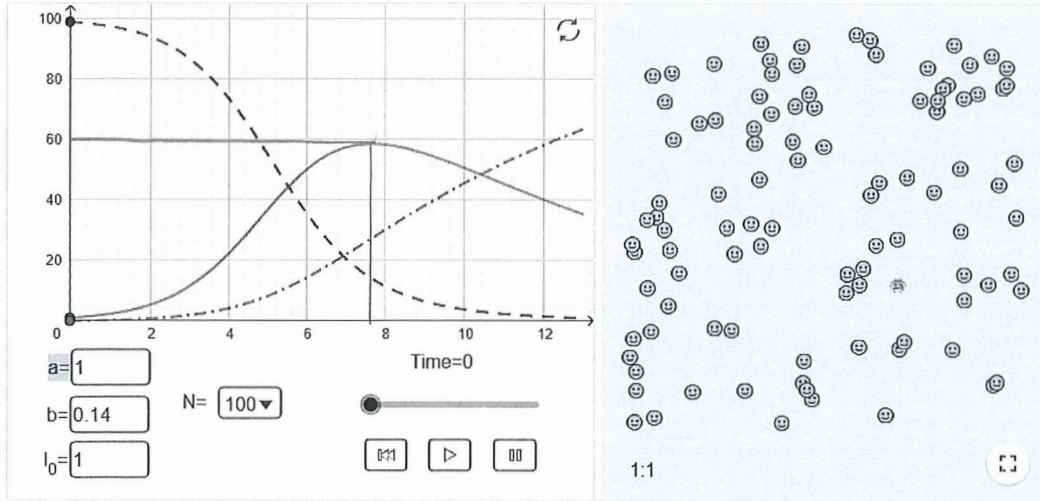
c) Assume that the whole population is susceptible to chicken pox and that 1% are initially infected.



■ $\frac{ds}{dt}$ ■ $\frac{dr}{dt}$ ■ $\frac{di}{dt}$

d) At the peak of the chicken pox outbreak, almost 70% of the population have the disease. This occurs when the time is 5.

e)



Transmission rate, a	Recovery rate, b	Use the peak for infectives	
		% infected	day this occurs
1.00	0.14	60	7
1.75	0.14	72	4
2.50	0.14	80	3

f) Avoid contact, face coverings, self-isolation.

The community may want to flatten the curve so hospitals have capacity
 Delaying the peak will make time to get medicines.

S-I-R Model - task 2

Task 2

a) The whole population is split into 3 groups: susceptible, infective and removed (s , i and r). If all groups are added together, they make up 100% of the population, meaning $s + i + r = 1$

b) $\frac{ds}{dt} = -asi$ shows the rate of change of the susceptible group. The negative sign indicates that the number of people in this group is decreasing, at a rate of asi , where a is the transmission rate.

$\frac{di}{dt} = asi - bi$ shows the rate of change of the infective group, which is made up of the people coming from the susceptible group, and the people leaving to the removed group, b being the recovery rate of the disease.

$\frac{dr}{dt} = bi$ shows the rate of change of the removed group, which is made up of the people leaving the infective group, which will increase until it reaches whatever the total population is.