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| Table 1: The Epidemic Modeling Unit | | | |
| Days | Learning activity | Guiding questions | Assessment |
| Day 1  (Engage) | Students ask questions about infectious diseases like COVID-19 and obtain information about COVID-19 and other epidemics from reading and videos. | * What is COVID-19? * What happens when people are infected with COVID-19? * How does COVID-19 transmit? * Why do scientists regard COVID-19 as a more severe infectious disease than influenza (flu)? * What are an epidemic and a pandemic? * How do scientists examine an epidemic? * How do scientists determine whether an intervention may mitigate an epidemic or not? | Students explain why COVID-19 is worse than most strains of the flu. |
| Day 2  (Explore) | Students analyze COVID-19 case data to identify the characteristics of epidemic curves. Students explore and learn about NetLogo and agent-based computer models. | * How does the number of new COVID-19 cases change over time? * What is an epidemic curve? * How does an epidemic curve form? * Why do epidemic curves differ in different countries? * What is an emergent phenomenon? * What are individual behaviors? * What is an agent-based simulation? | Students explain why or why not they think the epidemic curve is an emergent pattern. |
| Day 3-4  (Explore) | Students dissect the disease-spreading process and construct an agent-based computer simulation of an epidemic. | * What are the four phases of infectious disease? * What should be the agents in the epidemic simulation? * What are the characteristics of the agents? * How will the agents behave in the simulation? * What will happen in the simulation? | Studentsconstruct an agent-based computer model to simulate the transmission of COVID-19 in a human population. |
| Day 5  (Explain) | Students analyze and interpret computer-generated data to investigate the impacts of transmission rate, mortality, incubation period on epidemic development. | * How does an epidemic curve form in the simulation? * What factors may affect the epidemic development? * How do we measure the severity of an epidemic? * How does the transmission rate affect epidemic development? * How does mortality affect epidemic development? * What is a carrier? * How does the length of the incubation period affect the outbreak? | Students explain the impact of transmission rate and incubation period on epidemic curves using the evidence from the simulation. |
| Day 6  (Extend) | Students expand the computer simulation to investigate the impact of human mobility on epidemics. | * How may travel restrictions mitigate COVID-19? * What is a “flattened curve”? * Why do we need to flatten the epidemic curve? | Students explain why travel restriction may mitigate the COVID-19 pandemic supported by evidence from the computer simulation. |
| Day 7  (Extend) | Students expand the computer model to investigate the impacts of vaccination on epidemic and herd immunity. | * What is a vaccine? * How does the vaccine work? * What is herd immunity? * What factor may determine the herd immunity threshold? | Students explain the impact of vaccination rates on the COVID-19 pandemic supported by evidence from the computer simulation. |
| Day 8  (Evaluate) | Students reflect on the modeling activity and communicate knowledge gained from the unit. | * How do computer simulations help scientists study epidemics? * How do we know the computer simulations provide valid information to make practical decisions? * What are the limitations of this epidemic simulation? * What is needed to improve the accuracy of computer simulations? * Why is everyone involved in the COVID-19 pandemic and should everyone do his/her part to control the COVID-19 pandemic? | Students write a one-page letter to the public explaining how their and their community’s behaviors have affected and will affect the progression of the epidemic. |