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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. |